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PARACHUTE RIGGER 3 & 2

VOL. 1

NAVY
TRAINING
COURSES

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PARACHUTE RIGGER

3 & 2

Volume 1

Prepared by

BUREAU OF NAVAL PERSONNEL

NAVY TRAINING COURSES

NAVPERS 10358

UNITED STATES
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WASHINGTON : 1956

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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PREFACE

This course has been written for the purpose of helping enlisted men of the U. S. Navy and Naval Reserve to qualify for promotion to the rates of Parachute Rigger, Third Class and Second Class. It is one of a series of NAVY TRAINING COURSES designed to give men of the Navy the background information necessary to secure advancement in rating. Combined with the necessary practical experience, this training course will prepare the reader for the advancement-in-rating examination.

A study guide has not been included in the course because: (1) There are no emergency service ratings, and (2) there are no chapters which are exclusive to either PR3 or PR2.

The qualifications for Parachute Riggers are listed in appendix IV. This training course and its companion, volume 2, contain information on the technical qualifications for Parachute Riggers 3 & 2. Because the examinations for promotion are based exclusively on these qualifications, it is suggested that the strikers and PR3's refer to them frequently for guidance both in using these Navy Training Courses and in using the other publications listed in the Reading List.

This course starts with an introduction to the PR rating. Then attention turns to the types and components of parachutes, inspection, packing and rigging, jumping techniques, and the standard layout of a typical parachute loft. Sewing machines, fasteners, maintenance procedures, and seams are discussed. Volume 2 of this series discusses oxygen, regulators, fittings, systems, masks, and survival equipment. These two courses should be studied thoroughly. It should be remembered that these courses are not designed as aircraft equipment maintenance manuals and are not to be used as such.

As one of the NAVY TRAINING COURSES, this book represents the joint endeavor of the Navy Training Publications Center, Memphis, and the Training Division of the Bureau of Naval Personnel. Credit is also given to the Parachute Rigger School at Lakehurst, N. J. for their technical review and for supplying the end-of-chapter questions which review the materials contained in each chapter.

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READING LIST

Aircraft Survival Equipment, NavPers 10352–A
Aviation Storekeeper, Vol. 1, NavPers 10396–A
Safety & Survival Equipment for Naval Aviation, NavAer 00–80T–52
CO_2 Recharge Pump, NavAer 19–1–501
Oxygen Recharge Equipment, AN 19–5–17
Parachute Manual, NavAer 13–5–501
Naval Aircraft Oxygen Equipment Handbook, NavAer 03–50–517

THE PARACHUTE RIGGER AND EMERGENCY SERVICE RATINGS

The qualifications shown for PR in the appendix are those for the general service rating which is the only rating in effect at the time this book is being printed. However, it is planned to establish two emergency service ratings for Parachute Riggers soon. They will be as follows:

1. PARACHUTE RIGGERS M (Maintenance) maintain, service, repair, calibrate, and instruct in the operation, use, and care of aviators' breathing oxygen systems, liquid oxygen systems, storage and transfer equipment, servicing equipment, full pressure suits, pressure suit pressure/ventilation controls, composite disconnects, and associated equipment.
2. PARACHUTE RIGGERS S (Survival) maintain, service, repair, and instruct in use and maintenance of parachutes, carbon dioxide equipment for life rafts, safety belts and shoulder harnesses, cargo assemblies, air-sea rescue equipment, protective clothing, and survival kits.

This Navy Training Course, Vol. 1 of *Parachute Rigger 3 & 2*, contains materials that are concerned primarily with the qualifications of the PRS. Volume 2 will contain mostly materials for PRM's. However, both PRM and PRS should study the first chapter of this course. The Chapter Guide which follows directs the study of the pertinent parts of this course for PR's, PRM's, and PRS's.

Chapters	PR	PRM	PRS
1	X	X	X
2–10	X		X

PARACHUTE RIGGER 3 & 2

Volume 1

CHAPTER 1

MEET THE PARACHUTE RIGGER

DUTIES AND RESPONSIBILITIES

This NAVY TRAINING COURSE will introduce you to a fascinating field of activity for properly qualified and adequately trained men of the United States Navy. Your interest in this book and the rating that it covers are an indication that you may one day number yourself among the select group of Navy men known as Parachute Riggers.

The province of the Parachute Rigger is a far cry from what it was when the attack on Pearl Harbor brought the United States into World War II. The scope of his employment has so increased that it is now as varied as that of any rating in the Navy.

The Parachute Rigger of today has for his prime mission the business of saving lives. A pilot leaves his disabled plane and parachutes to safety; the crew of a ditched plane survive and thrive in their life rafts until found and brought in by Search and Rescue teams; another crew tames the rigors of the Greenland snowfields; because Parachute Riggers did their jobs well. They not only did their jobs well: they did them perfectly.

Not only does the Parachute Rigger pack and maintain those lifesaving spreads of nylon, but other equally important devices are placed in his keeping. Life rafts, life vests, survival kits, pilots' personal and protective equipment, and their amazing assortments of vital supplies, require his scheduled inspection to insure their operations under emergency conditions. In order to maintain parachutes, flight clothing, protective clothing, and other related fabric assemblies, it is necessary for the Parachute Rigger to know how to operate and adjust various types of sewing machines. Blueprint reading, laying out and cutting materials, all tie into this phase of his work. He must maintain the oxygen (O_2) and carbon dioxide (CO_2) systems of the Navy's aircraft. To do this requires a strict and unrelenting observance of the safety precautions involved in the handling of compressed gases during the transfer processes and in every single encounter with these materials. Liquid oxygen, CO_2, and O_2 transfer systems, safety belts and shoulder harnesses, high-pressure relief valves, rotary and oscillating sewing machines, all, are familiar materials and equipment to the Parachute Rigger, and all must be stored, handled, or maintained in perfect working order.

Note the qualifying word—PERFECT. Everything the Parachute Rigger does must be done flawlessly. Perfection becomes the standard by which he lives. The man who approaches his daily work with a tongue-in-cheek attitude should look elsewhere for his advancement. Such an approach leads only to trouble—quick, certain, and in large quantities—when a man is working with lifesaving equipment. The Parachute Rigger knows this, and the precept he always has before him is one that has never been improved upon where man works with his fellow man—the Golden Rule—"Do unto others as you would have them do unto you."

As aviation engineers solve the problems of performance, aircraft operate at ever higher altitudes. Operation at these altitudes demands an unfailing supply of breathing oxygen if the plane crews are to survive. Attendant with the use of oxygen to support life, the use of CO_2 is equally important. CO_2 extinguishes fires, inflates life rafts and life vests, and is another responsibility of the Parachute Rigger.

In addition to properly inspecting, packing, and rigging a parachute, the Rigger learns to perform the minor repairs necessary to maintain this highly specialized lifesaving device. And when he has mastered this, the original skill which names his rating, he makes a jump in a parachute he himself has packed. For this reason, if for no other, the emphasis on perfection and the Golden Rule becomes clear.

The pride in a completed jump is the source of a man's confidence in his ability to do the whole job assigned, and do it as it should be done. It is the "proof of the pudding" in a very personal sense. Moreover, it enables all of those who entrust their lives daily to his competence to do their essential jobs with complete confidence in his ability. The men of the United States Navy are a team in every sense of the word and the Parachute Rigger fills a proud position in the lineup.

Typical Billets

A description of some typical work assignments that a PR3 or PR2 could be assigned follows. Duty stations afloat could be as a crewmember aboard a CVA type vessel or as a member of a squadron. If assigned a vessel, you will be assigned to the applicable "V" division. You will work under the supervision of a division officer and a senior Parachute Rigger. The area and work assigned will involve parachutes, survival equipment, and oxygen equipment above the main deck. Work in the loft will require the packing and the general maintenance of parachutes, sewing machine repairs on parachute containers (packs), the making of authorized minor modifications to parachutes, and many other tasks involving machine and hand type sewing. Life rafts, life vests, and all related survival equipment must be kept in excellent working conditions. To do so requires a very active and taut scheduling, especially when squadrons are aboard. In the confined area of a one-table loft, such as is found aboard ship, everything depends on the parachute packing schedule. Other activities, except sewing and issuing, practically cease when packing is conducted. Cleanliness in the area is a major task at all times in the loft, especially during the parachute packing process.

A PR3 or a PR2 that has been assigned oxygen duties is responsible for the maintenance of the fittings, hose, tools.

and upkeep of the various oxygen transfer stations on the hangar and flight decks. During flight quarters he will be standing by an oxygen transfer outlet station ready to pay out flexible hose to the squadron Parachute Riggers. The squadron Rigger's job is to refill the oxygen system of his aircraft before the next flight; whereas, the ship's company Riggers make the oxygen available. Oftentimes it is necessary that squadron Riggers pay out and operate remotely situated stations.

Squadron Parachute Riggers are required to move from area to area, or wherever the squadron goes. Consequently, they learn to travel lightly and have to develop an anticipation for their needs. Spares are kept to a minimum as the Rigger learns the rules and policies of stocking and requisitioning. When operating from an air station, the Rigger is in contact with other parachute personnel of the supporting FASRon and sometimes air station activities. The oxygen transfer cart used on the line, being a bulky item of equipment, cannot be transported with the squadron. Usually it is issued by FASRon to one or more squadrons operating aboard the air station. It is the Rigger's duty to protect and maintain the cart while in his care. Repairs to the cart involving replacement of parts are usually made by FASRon personnel. Riggers operating oxygen transfer carts must be thoroughly familiar with all the operating safety precautions. Riggers assigned fighter and attack squadrons spend a great part of their time on duties related to oxygen and oxygen equipment.

Periodic inspections of aircraft oxygen systems, regulator changes and bench checks, inspection and maintenance of survival equipment, and the maintenance of pilot's personal gear—all keep the parachute crew busy.

Added to the above duties is the ever-changing scene of operations aboard different aircraft carriers which travel and stations which are located all over the globe. Thus, packing and unpacking, hauling and moving gear, preparing to go aboard ship, and disembarking are duties and factors that affect the daily life of Parachute Riggers.

PARACHUTE BACKGROUND

As far back as 1495, Leonardo da Vinci designed a parachute consisting of a pyramid of cloth. Many of da Vinci's ideas have been incorporated in modern parachutes.

In 1617, Fouste Veranzio jumped from a tower in Venice, using as a parachute a square, wooden framework covered with canvas.

This brief bit of background discloses that the idea of the parachute is by no means new. It also indicates that the numerous devices of yesteryear were intended primarily as forms of amusement. The possibilities of the parachute as a lifesaving device never occurred to any of the early designers as there was no need for an aerial lifesaving device.

Interest in parachutes was renewed in 1783, when the Montgolfier Brothers succeeded in making a balloon. In order to maintain the necessary supply of hot air to keep the balloon aloft, aerial navigators often burned bundles of straw beneath the bag. If the fabric caught fire, the flight was abruptly ended. The fact that men went aloft and that such flights made quick escape and descent imperative, removed the parachute from the stunt classification. In 1808, a Polish balloonist named Kuparento became the first aerialist to leap to safety with a parachute from his blazing bag of hot air.

For nearly a century following Kuparento's jump, the need for foolproof parachutes was not sufficiently acute to stimulate a great deal of inventive effort. When the Wright Brothers, in 1903, stayed aloft in their primitive plane at Kitty Hawk the air age came into being, and the parachute left the sideshow to become, once and for all, an integral part of aviation.

Now came a period of experimentation with parachutes especially designed for use with the new type of aircraft. The old balloon type of parachute had proven entirely unsatisfactory as it constantly fouled when used in the faster moving airplane.

The first successful jumps from aircraft were performed with makeshift parachutes. Grant Morton jumped from a plane carrying a loosely folded parachute in his arms.

After clearing the plane, he tossed the bundle of silk to the breeze where it caught and billowed. In 1912, Capt. Albert Berry made a jump using a parachute packed in a cone-shaped metal cylinder attached to the underside of the fuselage, just over the axle. Berry crawled from the cockpit to the axle and slid onto a trapeze bar which served as a "harness." When he jumped, the weight of his body pulled the parachute from the container.

During World War I, balloonists became observers and artillery fire directors, and because such duty was highly hazardous, these aviators wore parachutes. The record shows that the lives of 800 balloonists were saved by parachutes during the First World War.

Parachutes were not considered essential equipment for World War I aviators, and less than one one-hundredth of one percent of aerial missions made during that struggle were flown by pilots wearing parachutes. The resultant mortality rate among pilots on active duty at the front was very high. As a result, the need for an efficient, man-carrying parachute that could be used in an emergency became a primary requirement between 1916 and 1918, and both belligerents set about developing suitable ones.

Thus, out of World War I came various types of parachutes—the Heinecke (German), the Mears and Guardian Angel (British), the Orrs and S. T. A. (French), and the A. E. F. (American). All of these parachutes were heavy and unwieldy, and none were safe at speeds exceeding 100 miles per hour.

It was an accepted fact that parachutes could save lives if they worked. The next logical step was that of rendering them foolproof.

FOOLPROOFING PARACHUTES

Following the First World War, work on the development of parachutes was continued, chiefly at the Army Air Service Experimental Station at McCook Field, Dayton, Ohio.

Experience had shown that the attached type of parachute was wholly unreliable as an emergency unit, principally because of the unpredictable paths taken by disabled planes. Inverted positions, spins, or excessive speeds played havoc with the attached-type parachute. In 1919, after painstaking research and experimentation, a free-type parachute emerged that enabled the operator to release the canopy from a pack AFTER HE HAD JUMPED. Test after test with dummies proved that this type of parachute worked EVERY TIME.

Three years passed from the development of the free-type parachute to the successful demonstration of its value in saving a pilot's life. While flying over McCook Field in 1922, Lt. H. R. Harris subjected his plane to such violent maneuvers that the wings were torn off. Harris bailed out and his parachute brought him safely to earth.

Further experiments improved the parachute and produced the back, seat, chest, and lap styles. The successful parachute—termed type S—was deemed completely foolproof, and in 1924 orders were issued requiring all Navy and Army fliers to wear parachutes of this design.

AN EYE TO THE FUTURE

If you pick up a newspaper, or watch television, what you will learn about speeds and altitudes is enough to startle and fire the imagination of the most modern minded person. Aircraft are gaining new altitude records at such rates that it is difficult to keep up with them. Speeds have exceeded the 1,000 m. p. h. mark for human travel.

The higher one ascends into the upper air, the lower the surrounding pressure becomes. On the ground, man is accustomed to a pressure of 14.7 pounds per square inch to more or less hold him together, drive air into his lungs, and a number of other things that are taken for granted. But above 10,000 feet this picture begins to change. Medical science is spending millions of dollars yearly in developing equipment that will permit man to enter the stratosphere and return unimpaired and in as natural a state as possible. Everything is geared to high speeds and altitudes: high speeds and altitudes seem to be the watchword of the future.

To date, no one has come up with an antigravity belt (that works) and thereby put the parachute out of business. This is where you—the Parachute Rigger—make your entrance. Successful parachute descents have been made after the occupant has bailed out at speeds in excess of 600 m. p. h. The parachute held together and so did the jumper. Astounding? Perhaps, but man is a lot tougher than you might think. Today, we have fabrics available that are equal to the strength of the finest steel (measured strand for strand), and weigh much less than the steel. Scientists know just how far it can be extended before the present day parachute will fail and burst into ribbons. But are they certain as far as man is concerned? Where can they draw the line? Only the future will tell, and that problem is now being studied in the laboratories and experimental stations throughout the country.

The ejection seat is the present answer to escape from high-speed aircraft. This device literally shoots the pilot from the aircraft into space and virtually eliminates any possibility of his striking or becoming fouled with the aircraft structure. Following ejection from the plane, the jumper frees himself from the seat, and then pulls the ripcord, opening his parachute. All of this is very fine at comparatively low altitudes (20,000 feet or less). But how about 60,000 feet and higher? What about that low pressure mentioned earlier?

While one is safely seated in a pressurized cockpit or cabin, there is no worry regarding physical dexterity at any altitude within the limits of the system, but let that pressure suddenly be released and we immediately have trouble—trouble that can mean death in a matter of seconds to one so exposed. The Navy is developing a pressure suit that will inflate in a fraction of a second when the cockpit pressure is lost as the result of a bullet hole or other failure of the system. This sudden loss of external pressure is known as "explosive decompression." Picture the problems that lie ahead for the Navy's parachute designers in designing a rig that will permit a safe bail out under these conditions.

Visualize the oxygen system requirements to keep the aircrewman alive and well at 80,000 feet.

The future will doubtless find a solution to these problems and the Navy's Parachute Experimental Division at El Centro, California, is doing all that it can to test and prove new ideas that will lead us in the right direction.

THE PARACHUTE RIGGER SCHOOL

The Parachute Rigger School (Class A) was established at Lakehurst, New Jersey, in 1924. At the time it occupied a small lean-to built against a hangar. It was here that the first Navy Parachute Riggers were instructed. The curriculum covered packing a parachute, servicing a life raft and life vest, and operating a sewing machine. Parachute rigging in those days and up to World War II was an extracurricular activity. The Aviation Machinist and Aviation Metalsmith ratings handled the small added task of parachute rigging along with their other duties. The work of the Parachute Rigger had increased to such an extent by 1942 that the Bureau of Naval Personnel established the Parachute Rigger rating. Aviation Machinists and Metalsmiths performing parachute work then had to decide whether to retain those ratings or make the change to this new rating of Parachute Rigger.

In order to become a Parachute Rigger, it is necessary to graduate from the Parachute Rigger School (Class A). One premeditated free-fall descent using a parachute packed by the applicant under the supervision of a qualified instructor is a requirement for graduation. Before the prospective trainee can start instruction he must meet the standards set by the Navy, including certain scholastic and physical requirements. These qualifications must be determined and met before a man is sent to Lakehurst.

SCOPE AND CONTENT

This volume and volume 2 of the Parachute Rigger series of NAVY TRAINING COURSES are designed to help meet the requirements for advancement in rating for the Parachute

Rigger 3 and 2. The requirements, as far as knowledges and skills required, are set forth in the *Manual of Qualifications for Advancement in Rating*, NavPers 18068 (Revised). The "qualifications" related to the Parachute Rigger are discussed later in this chapter and are reproduced in appendix IV.

These volumes are not intended to be technical maintenance manuals and used in the servicing and repair of parachutes and equipment. Instead they are training manuals and attempt to describe in general terms the operational procedures and systems in order to teach knowledges and skills required for advancement in rating.

In order for the Parachute Rigger to keep up to date on the latest equipment and procedures, he must refer to current directives.

HOW TO USE THIS COURSE

In studying this training course, first read each chapter through completely. Then reread it again carefully. By so doing, you will be able to fully comprehend and understand it. Do not overlook the illustrations. This course is profusely illustrated and much knowledge and many skills can be acquired by studying the illustrations. Answer the end-of-chapter questions. They are written to make you think, study, and reread portions of the chapter.

QUALIFICATIONS

You will find the qualifications required for advancement in rating for the Parachute Rigger in appendix IV of this NAVY TRAINING COURSE. These qualifications are divided into two groups: PRACTICAL FACTORS and EXAMINATION SUBJECTS.

Practical factors are those qualifications which are best determined by observing the candidate for advancement in rating perform under actual working conditions.

Examination subjects are those qualifications which can best be determined by means of a written examination.

You will find that both study and practice are necessary to prepare for advancement. Study the qualifications which apply to the rate for which you are striking. Strikers for Parachute Rigger 3 need learn only those qualifications marked 3 in the applicable rate column. A Parachute Rigger 3 studying for advancement should already know the qualifications marked 3 and must learn those marked 2.

You can best learn most of the practical factors by practicing, observing, and asking questions of officers and petty officers. To master the examination subjects, you should study NAVY TRAINING COURSES and other appropriate publications.

PUBLICATIONS

Technical publications play an important role in the Parachute Rigger's work. Due to the nature of survival equipment it is advisable to direct attention to them. OpNav and BuAer Bulletins and Instructions, Safety Bulletins, and related Technical Manuals furnish the Parachute Rigger with his principal means of keeping up with changing techniques. Keeping up to date is essential to successful rigging and is part of the process of realizing all the improvements that have been built into an item of equipment. The Parachute Rigger is always responsible for knowing and applying the latest information contained in these publications, which will be treated in detail in later chapters.

QUIZ

1. Which of the following is the most important standard by which a qualified Parachute Rigger works?
   - **a. Perfection**
   - **b. Neatness**
   - **c. Interest**
   - **d. Ability**

2. Who was the first man to design a parachute?
   - a. Fouste Veranzio
   - b. Leonardo da Vinci
   - c. Kuparento
   - d. Montgolfier

3. In what year did Fouste Veranzio jump from a tower in Venice, using a square wooden framework covered with canvas as a parachute?
   - a. 1495
   - b. 1617
   - c. 1783
   - d. 1808

4. In what year was the first successful emergency parachute jump made?
   - a. 1808
   - b. 1818
   - c. 1880
   - d. 1888

5. What was the first completely foolproof type parachute termed?
   - a. Type A
   - b. Type B
   - c. Type S
   - d. Type T

6. In what year were orders issued for all flying personnel to wear parachutes?
   - a. 1914
   - b. 1918
   - c. 1920
   - d. 1924

7. How many lives were saved by parachutes during World War I?
   - a. 500
   - b. 600
   - c. 700
   - d. 800

8. The American type of parachute to come out of World War I was the
   - a. Guardian Angel
   - b. Orrs
   - c. S. T. A.
   - d. A. E. F.

9. The free-type parachute emerged in the year
    a. 1914
    b. 1918
    c. 1919
    d. 1924
10. In what year was the Parachute Rigger School established at Lakehurst, New Jersey?
    a. 1914
    b. 1918
    c. 1920
    d. 1924
11. In what year did the Bureau of Naval Personnel establish the Parachute Rigger rating?
    a. 1924
    b. 1930
    c. 1942
    d. 1945
12. In what year was the parachute first designed?
    a. 1495
    b. 1617
    c. 1783
    d. 1808
13. How can you best learn the practical factors about the Parachute Rigger rating?
    a. Reading this manual
    b. Study NAVY TRAINING COURSES
    c. Reading the *Parachute Manual*
    d. Practicing and observing

CHAPTER 2

TYPES AND COMPONENTS OF PARACHUTES

OPERATION OF A PARACHUTE

"It doesn't mean a thing if you don't pull that string." The expression certainly applies to the "free-fall" type parachute.

You have probably heard that a parachute operates something like this—"The jumper pulls a cord and out pops a nylon umbrella which inflates and lets him float safely to earth." Actually there is little more to the operation. It is the purpose of the first part of the chapter to give you a better understanding of just what does occur during the operation of a parachute. Thence, you will have a better picture of the relationship of parts. Jumping techniques and procedures will be explained later. We are now interested in the mechanics of the parachute.

A parachute is not made up of gears, shafts, and bearings, as are many things with which you may be more familiar. A complete service parachute consists of (1) the pilot chute, (2) the canopy, (3) the suspension lines, (4) the pack, and (5) the harness. The pilot chute is a small parachute attached to the top of the main canopy. Its purpose is to pull the canopy from the pack quickly. The canopy is the large umbrella-like area of nylon cloth which slows the descent of the jumper. The suspension lines are the lines which connect the canopy to the harness. The pack is the nylon assembly which encloses the pilot chute, canopy, and suspension lines. The harness is an arrangement of nylon webbing and metal fittings. It is worn by the jumper and can provide a

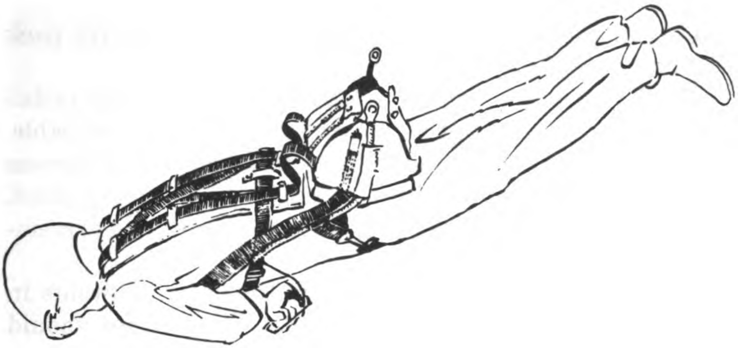


Figure 2–1.—Exerting a pull in excess of 22 lbs. on the ripcord releases the ripcord pins from the locking cones. The sides and ends of the pack are then drawn back by spring opening bands.

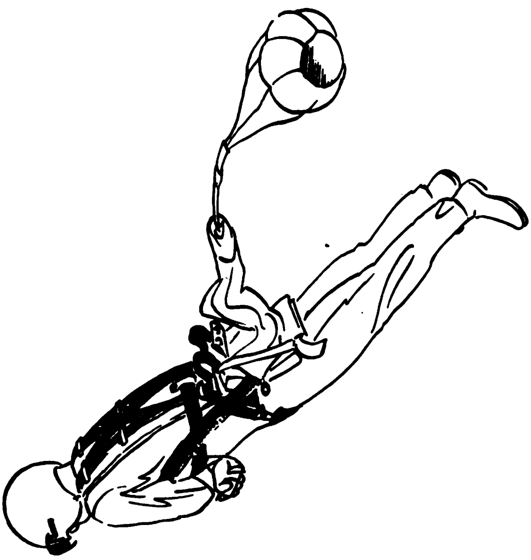


Figure 2–2.—The pilot chute springs from the pack and immediately opens. The pilot chute is thrown beyond the negative pressure area immediately above the falling body. This results in its getting a better "bite" on the surrounding air and thus speeds the opening of the main canopy.

seat or sling during descent. It also serves to carry the pack when the parachute is being worn.

The device which trips or releases the parachute is called a ripcord. It consists of a grip or handle, a length of cable, and two or more short pins. It is fastened to the harness and pack by means of a pocket, a housing, and locking cones. The importance of its working properly cannot be overemphasized.

Figures 2–1 through 2–7 illustrate the order of events in the operation of a parachute. These illustrations should be studied until the chain of events is thoroughly understood.

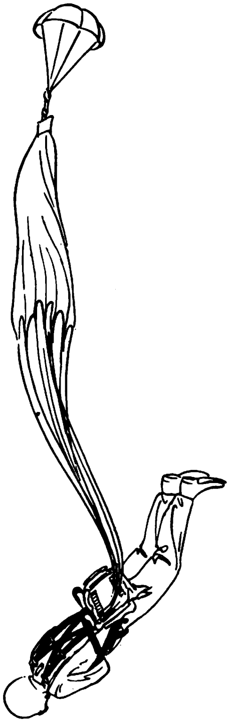


Figure 2–3.—Canopy completely extended. Suspension lines almost out of pack.

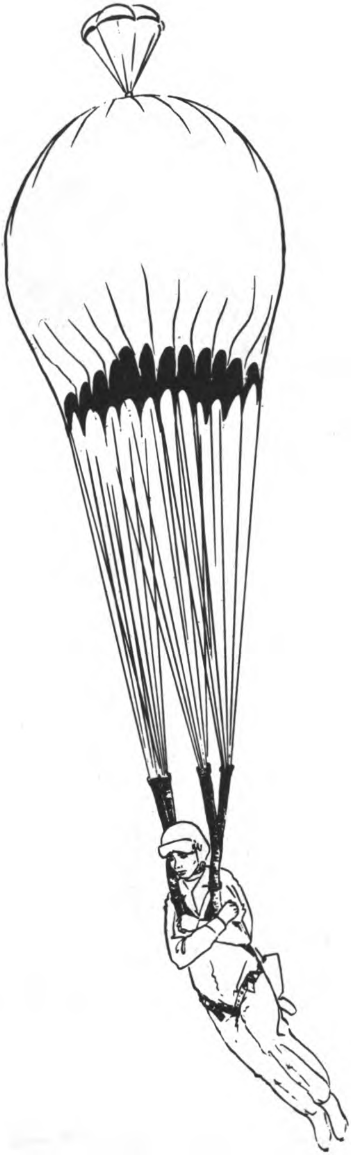


Figure 2–4.—Canopy filling with air. Body assuming an upright position.

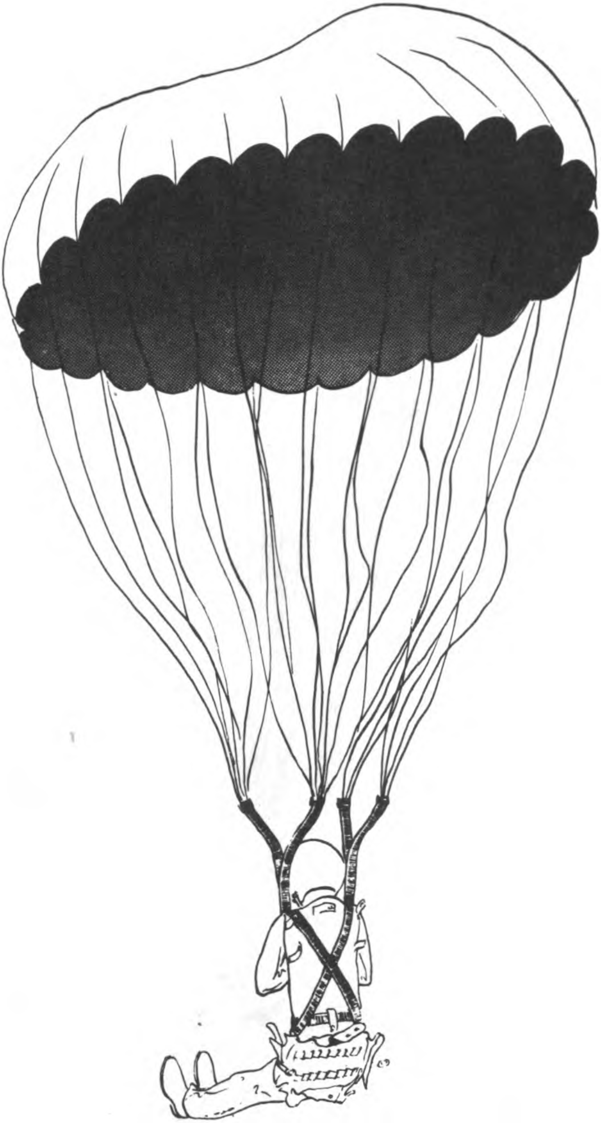


Figure 2–5.—Canopy completely open. Riser or lift web tackings broken. Lift webs pulled from pack. Opening shock felt.

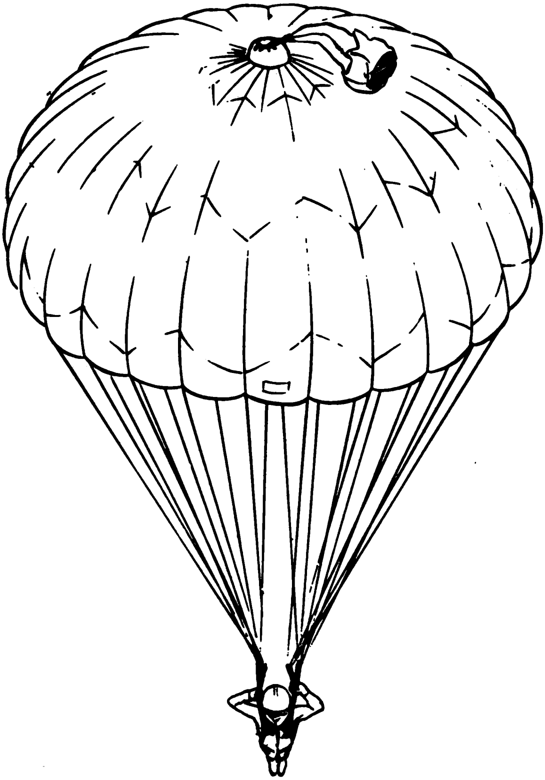


Figure 2–6.—Parachute fully open. Canopy has assumed normal inflated shape and size. Steady rate of descent established. Pilot chute, no longer needed, resting on canopy.

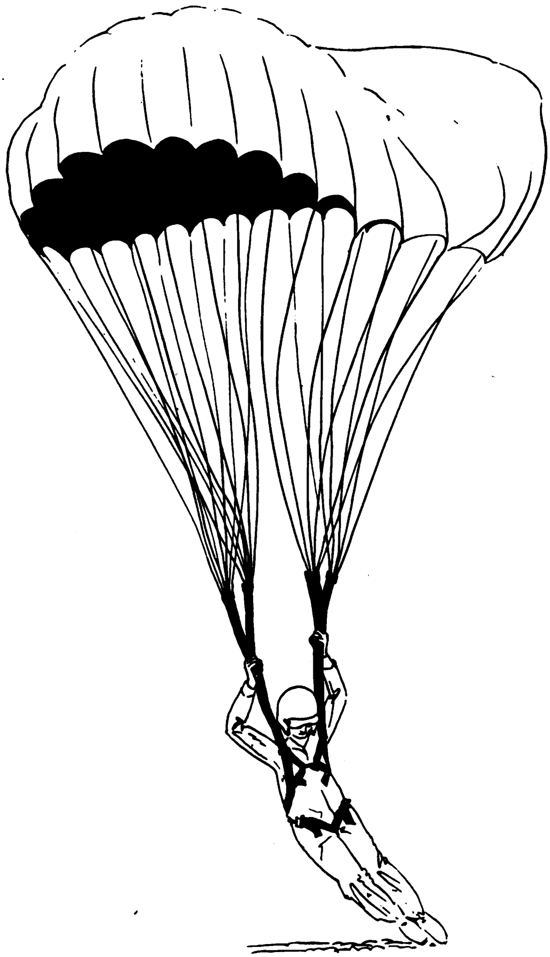


Figure 2–7.—Parachute deflating as body touches ground.

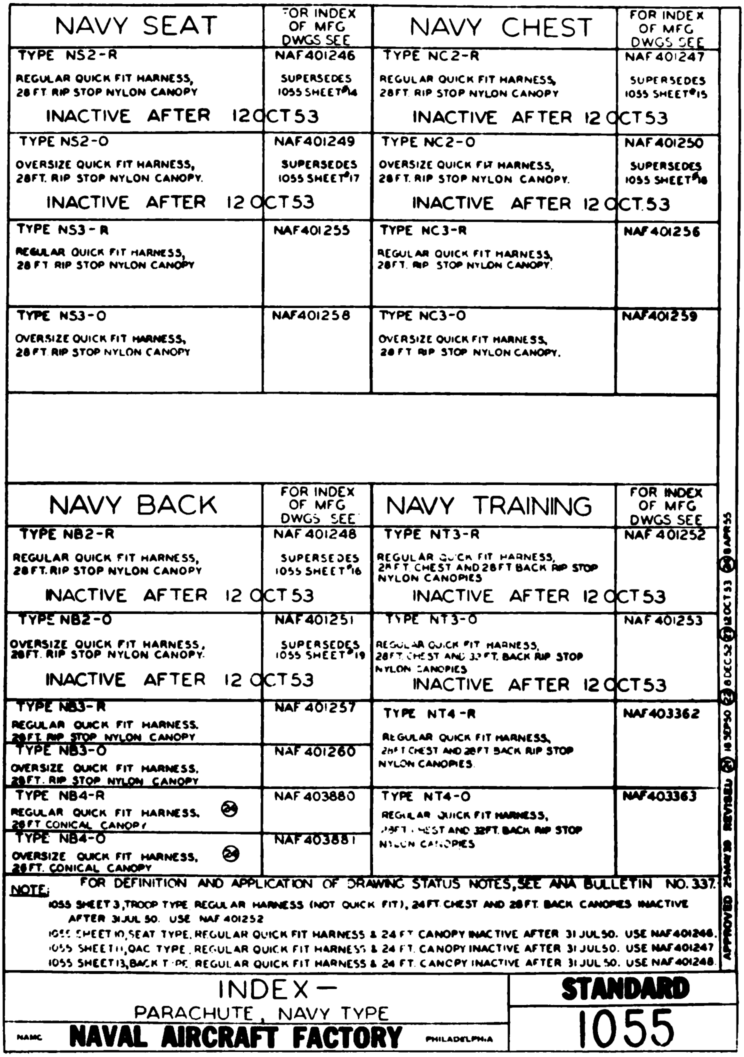
NAVAL AIRCRAFT FACTORY (NAF) PARACHUTE INDEX SHEET 1055

Now that you have seen how a parachute operates and have an understanding of the relationship of parts, the next step will be a close study of the various subassemblies that comprise a parachute. The Naval Aircraft Factory (NAF) Parachute Index Sheet 1055 is the key to the individual parachute indexes which lists parts relative to each particular model. From time to time you will find it necessary to use drawings or blueprints. The source of this information is the *List of Aeronautical Standard Drawings* used by the Bureau of Aeronautics. It will help you if you know how to find the particular drawing that you need. It lists the following types of drawings: AN Aeronautical Standard Drawings, AND Aeronautical Design Standard Drawings, MS Standard Drawings, and NAF Standard Drawings. The foreword to this list explains the designations, symbols, and revisions used, and how to order the drawings.

For the most part, designing of parachutes for naval personnel is done at the Naval Aircraft Factory. As a result, all drawings of Navy parachutes are either made or proved there. Drawings are identified by a number and a name or title.

One drawing that will become familiar is Naval Aircraft Factory Standard 1055 (abbreviated NAF Standard 1055). Its title is, "INDEX, Parachute, Navy Type." It is usually referred to as NAF Parachute Index Sheet 1055. Figure 2–8 illustrates this drawing. Listed are the various models of seat, chest, back, and training parachutes used by the Navy. Opposite each model listed on the index sheet is shown a drawing number. For example, opposite the listing of type NS3–R is listed NAF401255. The column heading shows that NAF401255 is an index of manufacturing drawings. This means that drawing NAF401255 lists each item that goes to make up a type NS3–R parachute. Opposite the name of each item listed is shown a drawing number. These numbers are the numbers of the blueprints that show the complete detail of the particular part.

Thus, by starting with the index sheet (NAF Standard Drawing 1055), it is possible to find the number of the blueprint showing details of any part of any Navy parachute.



NAVY SEAT	FOR INDEX OF MFG DWGS SEE	NAVY CHEST	FOR INDEX OF MFG DWGS SEE
TYPE NS2-R REGULAR QUICK FIT HARNESS, 28 FT RIP STOP NYLON CANOPY INACTIVE AFTER 12 OCT 53	NAF 401246 SUPERSEDES 1055 SHEET #14	TYPE NC2-R REGULAR QUICK FIT HARNESS, 28 FT RIP STOP NYLON CANOPY INACTIVE AFTER 12 OCT 53	NAF 401247 SUPERSEDES 1055 SHEET #15
TYPE NS2-O OVERSIZE QUICK FIT HARNESS, 28 FT. RIP STOP NYLON CANOPY. INACTIVE AFTER 12 OCT 53	NAF 401249 SUPERSEDES 1055 SHEET #17	TYPE NC2-O OVERSIZE QUICK FIT HARNESS, 28 FT. RIP STOP NYLON CANOPY. INACTIVE AFTER 12 OCT. 53	NAF 401250 SUPERSEDES 1055 SHEET #18
TYPE NS3-R REGULAR QUICK FIT HARNESS, 28 FT RIP STOP NYLON CANOPY	NAF 401255	TYPE NC3-R REGULAR QUICK FIT HARNESS, 28 FT. RIP STOP NYLON CANOPY.	NAF 401256
TYPE NS3-O OVERSIZE QUICK FIT HARNESS, 28 FT RIP STOP NYLON CANOPY	NAF 401258	TYPE NC3-O OVERSIZE QUICK FIT HARNESS, 28 FT RIP STOP NYLON CANOPY.	NAF 401259

NAVY BACK	FOR INDEX OF MFG DWGS SEE	NAVY TRAINING	FOR INDEX OF MFG DWGS SEE
TYPE NB2-R REGULAR QUICK FIT HARNESS, 28 FT. RIP STOP NYLON CANOPY INACTIVE AFTER 12 OCT 53	NAF 401248 SUPERSEDES 1055 SHEET #16	TYPE NT3-R REGULAR QUICK FIT HARNESS, 28 FT CHEST AND 28 FT BACK RIP STOP NYLON CANOPIES INACTIVE AFTER 12 OCT 53	NAF 401252
TYPE NB2-O OVERSIZE QUICK FIT HARNESS, 28 FT. RIP STOP NYLON CANOPY. INACTIVE AFTER 12 OCT 53	NAF 401251 SUPERSEDES 1055 SHEET #19	TYPE NT3-O REGULAR QUICK FIT HARNESS, 28 FT. CHEST AND 32 FT. BACK RIP STOP NYLON CANOPIES INACTIVE AFTER 12 OCT 53	NAF 401253
TYPE NB3-R REGULAR QUICK FIT HARNESS. 28 FT. RIP STOP NYLON CANOPY	NAF 401257	TYPE NT4-R REGULAR QUICK FIT HARNESS, 28 FT CHEST AND 28 FT BACK RIP STOP NYLON CANOPIES	NAF 403362
TYPE NB3-O OVERSIZE QUICK FIT HARNESS. 28 FT. RIP STOP NYLON CANOPY	NAF 401260		
TYPE NB4-R REGULAR QUICK FIT HARNESS. 28 FT CONICAL CANOPY ㉔	NAF 403880	TYPE NT4-O REGULAR QUICK FIT HARNESS, 28 FT. CHEST AND 32 FT. BACK RIP STOP NYLON CANOPIES	NAF 403363
TYPE NB4-O OVERSIZE QUICK FIT HARNESS, 28 FT. CONICAL CANOPY ㉔	NAF 403881		

NOTE: FOR DEFINITION AND APPLICATION OF DRAWING STATUS NOTES, SEE ANA BULLETIN NO. 337.

1055 SHEET 3, TROOP TYPE REGULAR HARNESS (NOT QUICK FIT), 24 FT. CHEST AND 28 FT. BACK CANOPIES INACTIVE AFTER 31 JUL 50. USE NAF 401252

1055 SHEET 10, SEAT TYPE, REGULAR QUICK FIT HARNESS & 24 FT CANOPY INACTIVE AFTER 31 JUL 50. USE NAF 401246.

1055 SHEET 11, QAC TYPE, REGULAR QUICK FIT HARNESS & 24 FT. CANOPY INACTIVE AFTER 31 JUL 50. USE NAF 401247

1055 SHEET 13, BACK TYPE, REGULAR QUICK FIT HARNESS & 24 FT. CANOPY INACTIVE AFTER 31 JUL 50. USE NAF 401248.

APPROVED 25 MAY 39 REVISED ㉑ 18 SEP 50 ㉒ 6 DEC 52 ㉓ 12 OCT 53 ㉔ 8 APR 55

INDEX —
PARACHUTE, NAVY TYPE

NAMC **NAVAL AIRCRAFT FACTORY** PHILADELPHIA

STANDARD
1055

Figure 2–8.—NAF Index Sheet 1055.

TYPES OF PARACHUTES

There are three basic types of parachutes now in service use by the Navy. These are the chest, seat, and back types. A fourth, the training or troop type jump outfit, is used in limited numbers for experimental and training purposes. The term SERVICE is used to refer to those parachutes (seat, back, and chest types) used primarily for emergency jumps and does not include the training types.

Navy Chest Type Parachute

Figure 2–9 illustrates the attachable chest type parachute. This parachute is designated as type NC3–R or type NC3–O. The letter "N" is the designation for Navy, the "C" for chest,

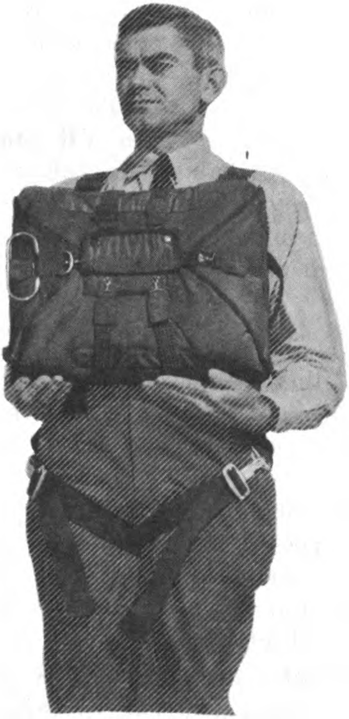


Figure 2–9.—Chest type parachute.

and the "3" means that it is the third change or modification of the basic design. The letters "R" or "O" mean that the harness is either "regular" size or "oversize." The pack of this parachute is attached to the harness with quick connector hardware and is worn on the chest. This parachute was designed for the use of pilots and crewmen whose duties require freedom of movement away from their regular flight stations. When the chest type parachute is used, the regulations require that the harness be worn at all times during flight. The pack is usually stored in an accessible spot either near the individual's flight station or bail-out station permitting the crewman to maintain operating efficiency and still provide a high degree of safety. This accessibility of the pack allows quick attachment to the harness before bailing out. To be completely effective, it is absolutely necessary that every person using a chest type parachute be properly trained in its use. It is obvious that each person aboard an aircraft should be continuously aware of the exact location of his pack at all times. The chest type parachute is designed for use in VA, VP, and VR type aircraft. Future development will probably bring about an acceptable attached parachute which will provide the same freedom of movement as the present harness and provide the additional safety of the attached pack.

Navy Seat Type Parachute

Figure 2–10 illustrates the Navy seat type parachute. Seat type parachutes are designated as type NS3–R or type NS3–O. The regular size harness (NS3–R) is shown in figure 2–10.

The seat parachute is the most universally used and is one of the oldest types. Seat types were formerly designated SS (standard seat). The first of the SS parachutes had a 24-foot canopy and was used in 1924. The SS model continued in use well into the 1940's.

The critical material shortages of World War II brought about design changes and material substitutions in parachutes as well as in other things. The need for conservation

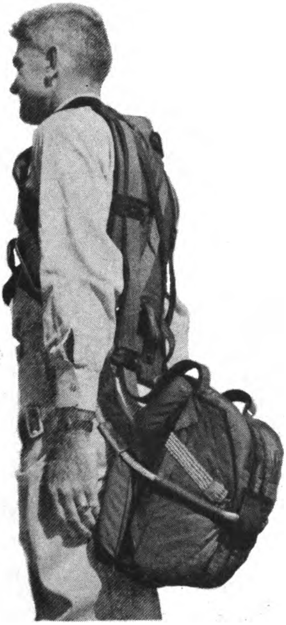


Figure 2–10.—Seat type parachute.

of materials hastened the development of the Quick Attachable Seat Type Parachute (designated the QAS). Along with the development of the QAS parachute came the quick fit harness. The pack was made so that it could be quickly attached to the harness. The separate harnesses were made so that they could be readily adjusted to the wearer.

Later a further improvement resulted in the development of a harness that could be adjusted to the individual wearer in almost a matter of seconds. Parachutes equipped with this harness were known as the Quick Fit Seat (QFS). The pack and harness were not detachable.

In 1948 the QFS was redesignated the NS2–R. Design and development of this parachute was carried out at the Naval Air Material Center. It is usable in all types of carrier aircraft.

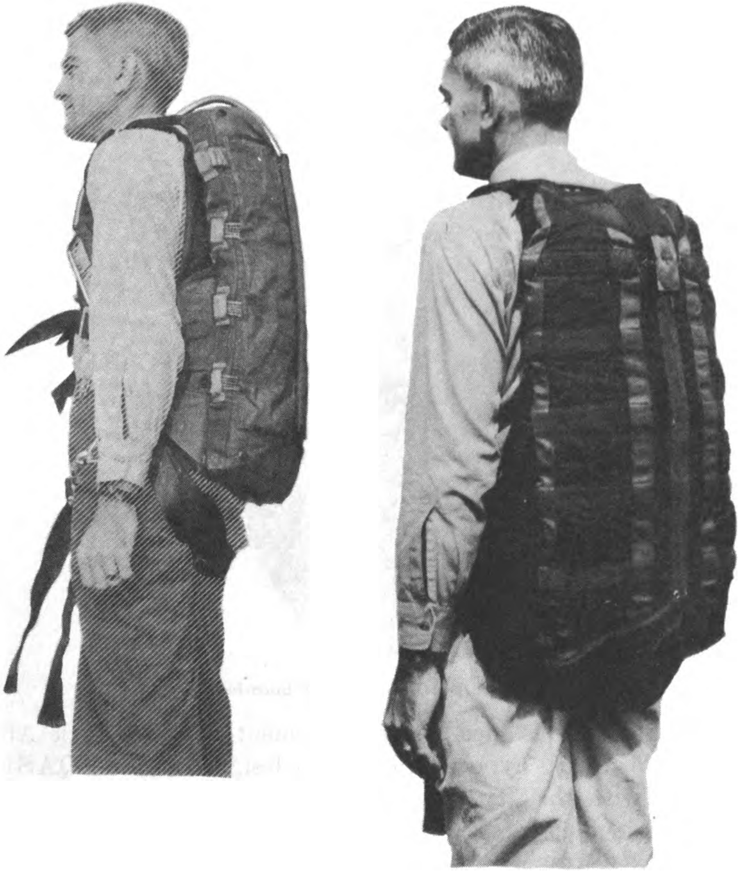


Figure 2–11.—Back type parachute. (A) NB3–R; (B) NB4–R.

Navy Back Type Parachute

The back type parachute, NB3–R, illustrated in figure 2–11, view (A), has had little use as a service parachute. This parachute is designated as type NB3–R or type NB3–O, depending on whether the regular or oversize harness is used. For awhile it was used by some VA and VP squadrons but did not prove satisfactory. A major objection to a back pack is that it puts the wearer too far forward in the seat.

This is particularly undesirable in fighter type aircraft as the pilot is placed so far forward that the protection of the seat armor is greatly reduced. Improvements in design of the pack has resulted in wider use as a service parachute.

At the time quick fit harnesses were developed, the back pack parachute was known as the QFB (quick fit back). In 1948 it was designated the NB2–R (Navy, back, first modification in design, regular size harness). Further modifications in design resulted in the designation being changed to NB3–R in 1953.

The latest back type parachute, NB4–R, is shown in figure 2–11, view (B). It is compactly designed for ease of wearing and comfort; and more important is its smooth finish which obviates the danger of its becoming caught on aircraft structural projections. The canopy is smaller than the older standard type which permits the application of a very thin and lightweight pack. The NB4 introduces a radically different opening device, employing a lock chain arrangement down the center of the pack. Only one external pack opening band is used at the top of the pack to help initiate a more positive opening when the ripcord is pulled. Spring steel bands, embedded in the side flaps, exert the necessary force to open the pack completely.

Present development indicates a more universal use of the back type parachute.

Parachute Assembly—Training Type

Figure 2–12 illustrates the training outfit. For all practical purposes, it may be considered as a standard back pack parachute with a chest pack attached to the same harness. Bureau of Aeronautics regulations, like those of the Civil Aeronautics Administration, require that two packs be worn when making training or demonstration parachute jumps. The training assemblies are designated type NT4–R or type NT4–O, depending on whether the harness is a regular or oversize one. Both canopies of the outfit with a regular size harness are 28 feet in diameter. In the outfit with an

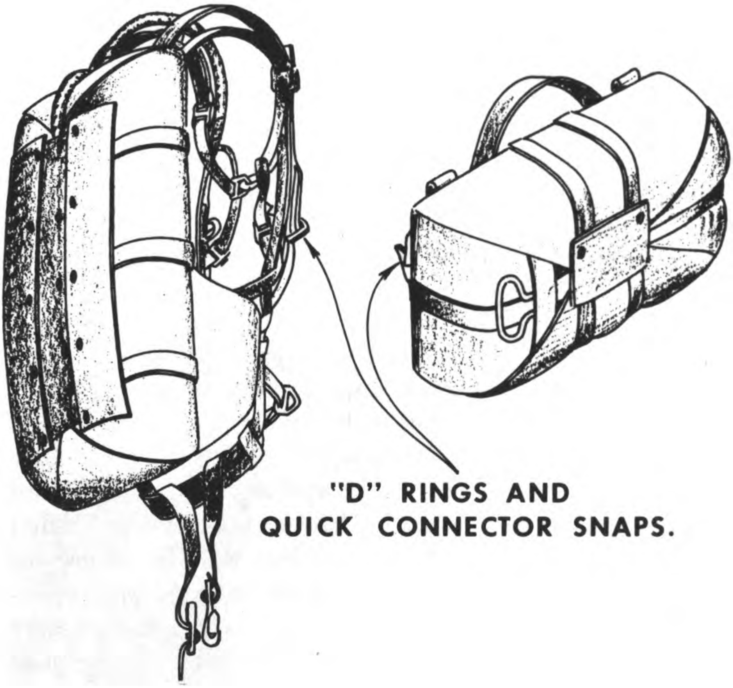


Figure 2–12.—Troop type training assembly.

oversize harness the canopy of the back pack is 32 feet in diameter while the canopy of the chest pack is 28 feet. In speaking of the chest pack, the designation would simply be NT4, since there is no harness attached to it. In the past, the training chest packs have been designated TC and the training back pack as TB.

The training outfit is rarely used in the Navy except at the Parachute Rigger School at Lakehurst, New Jersey, and the Parachute Experimental Division at El Centro, California. In order for naval personnel to make a premeditated jump at other than these two activities, it is necessary to pass a rigid physical examination and to have obtained, through the chain of command, the permission of the Chief of Naval Operations.

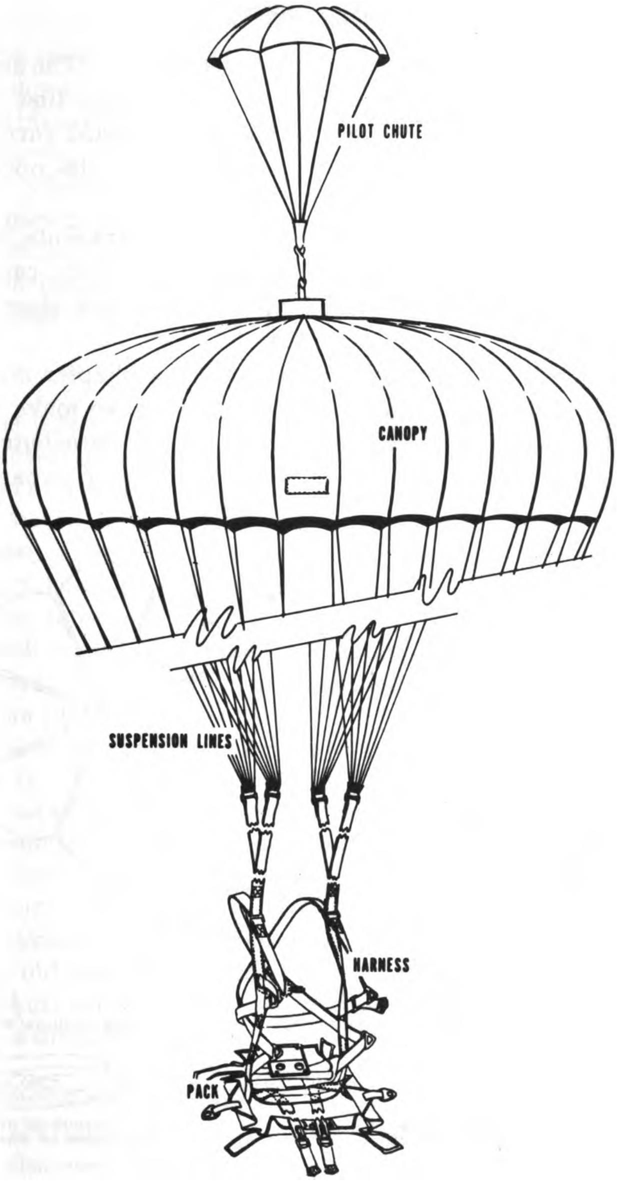


Figure 2–13.—The five major parts of a parachute.

"A chain is no stronger than its weakest link." The design and the construction of a parachute is based on that idea. Every link from the jumper to the canopy must carry its share of the maximum load applied during the opening shock.

The five major parts of a standard service parachute, starting at the top and working down, are pilot chute, canopy, suspension lines, harness, and pack. These are shown in figure 2–13.

The NAF drawing selected earlier in the chapter may be used in reviewing the subassemblies that go to make up a complete Navy seat type parachute. This parachute has the regular size harness and a 28-foot, ripstop, nylon canopy.

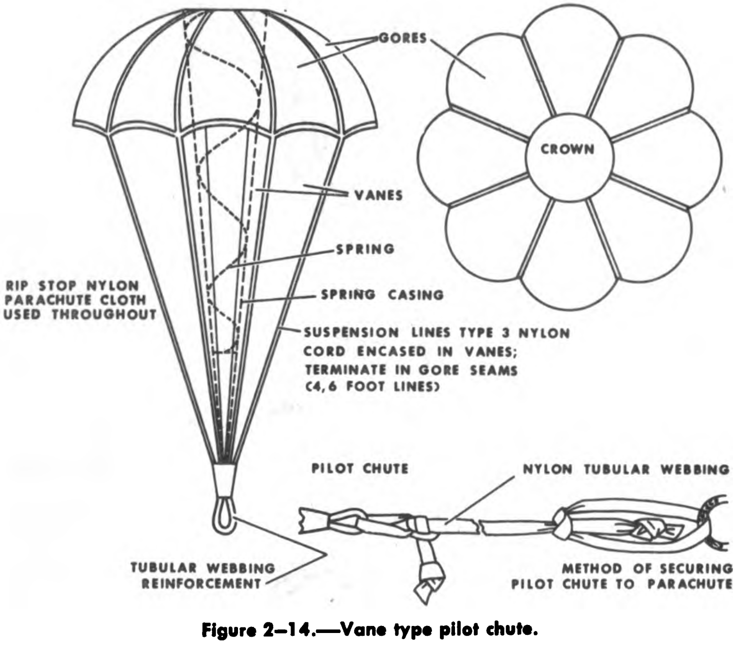

GORES
CROWN
VANES
SPRING
RIP STOP NYLON PARACHUTE CLOTH USED THROUGHOUT
SPRING CASING
SUSPENSION LINES TYPE 3 NYLON CORD ENCASED IN VANES; TERMINATE IN GORE SEAMS (4,6 FOOT LINES)
PILOT CHUTE
NYLON TUBULAR WEBBING
TUBULAR WEBBING REINFORCEMENT
METHOD OF SECURING PILOT CHUTE TO PARACHUTE

Figure 2–14.—Vane type pilot chute.

Pilot Chute

The vane type pilot chute (fig. 2–14) is used on all Navy parachutes; however, the one used on the NB4–R is smaller and differs slightly in material and construction.

Securing the pilot chute to the parachute is a rigging problem. The method used will be discussed in chapter 4.

Figure 2–14 shows the nomenclature or names of parts and materials that make up a pilot chute. A knowledge of this nomenclature and materials will prove valuable in your future work with parachutes.

Canopies

The size and shape of the parachute canopy has been a controversial subject ever since Leonardo da Vinci envisioned a pyramid of cloth as being the answer to a safe method of descent. Today the use of the parachute has been greatly broadened, but the overall acceptance of a reliably designed canopy has narrowed to two shapes. One is the old and proven reliable, standard flat type design, which has remained unchanged, except for minor revisions, for the past 30 years. The second is a new idea in construction but still follows the basic shape pattern. This type is known as the 26-foot 22-gore conical canopy. Its designation is the NB4–R or O. The "conical" reference comes from the fact that the peak of the canopy is conical in construction. In descent the conical canopy presents a slightly raised shape at the apex, but fails to radically change the basic appearance so familiar to the service.

STANDARD FLAT TYPE.—The 28-foot, ripstop, nylon canopy is the old standard size used on all Navy parachutes. The parachute sail or canopy is described as a polygon having 28 sides, a diameter of 28 feet ±1 inch, and 28 gores of 4 sections each.

It has been established that the purpose of the parachute is to retard the fall of the jumper or descending object. We have also seen that the canopy is designed to absorb the opening shock without tearing. This explains the necessity for care and precision in canopy construction.

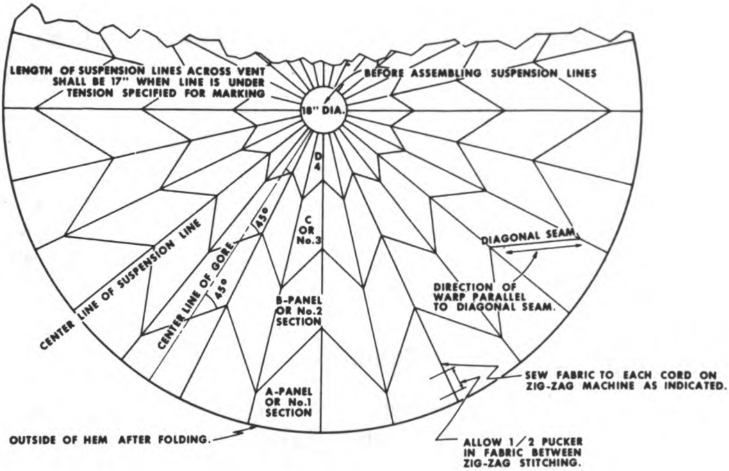
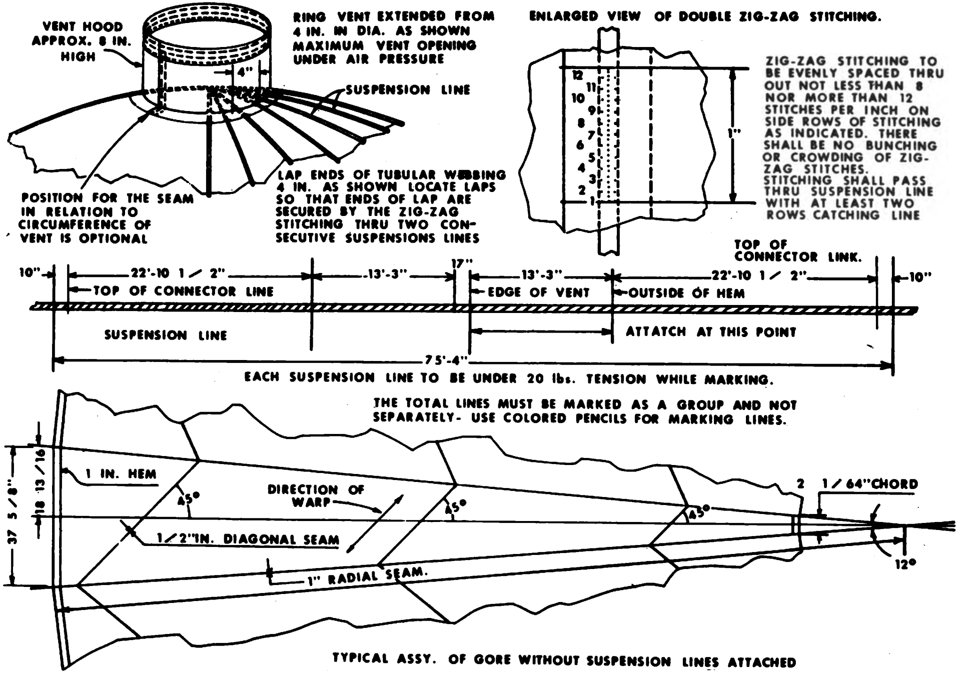

LENGTH OF SUSPENSION LINES ACROSS VENT SHALL BE 17" WHEN LINE IS UNDER TENSION SPECIFIED FOR MARKING
BEFORE ASSEMBLING SUSPENSION LINES
18" DIA.
D 4
C OR No.3
45°
45°
CENTER LINE OF SUSPENSION LINE
CENTER LINE OF GORE
DIAGONAL SEAM
DIRECTION OF WARP PARALLEL TO DIAGONAL SEAM.
B-PANEL OR No.2 SECTION
A-PANEL OR No.1 SECTION
SEW FABRIC TO EACH CORD ON ZIG-ZAG MACHINE AS INDICATED.
OUTSIDE OF HEM AFTER FOLDING.
ALLOW 1/2 PUCKER IN FABRIC BETWEEN ZIG-ZAG STITCHING.

Figure 2–15.—The 28-foot, ripstop, nylon canopy.

The 28-foot canopy requires approximately 796 square feet of nylon cloth plus 2,400 yards of nylon thread. The sewing on a parachute varies from 8 to 11 stitches per inch.

From the above we can determine interesting bits of information. A parachute canopy contains approximately half a million stitches. The area of the canopy is as great or greater than many two-bedroom homes. A complete parachute outfit ranges in price, depending on the type, from $140 to $300 apiece. That's little enough to pay for such a vast amount of safety.

Figures 2–15 and 2–16 illustrate the 28-foot canopy. The listing of the components of the canopy was taken from the NAF blueprint referenced in the index for the seat type parachute. It is interesting to note that on another index sheet the same size canopy is used with the oversize harness. One might expect the 32-foot canopy to be used with the oversize harness, however, this would require a larger pack and a change in the bucket seat size. The opening time of the 32-foot parachute is not as fast as the 28-foot assembly. It should be pointed out that 32-foot, ripstop, nylon para-



RING VENT EXTENDED FROM 4 IN. IN DIA. AS SHOWN MAXIMUM VENT OPENING UNDER AIR PRESSURE

LAP ENDS OF TUBULAR WEBBING 4 IN. AS SHOWN LOCATE LAPS SO THAT ENDS OF LAP ARE SECURED BY THE ZIG-ZAG STITCHING THRU TWO CONSECUTIVE SUSPENSIONS LINES

ZIG-ZAG STITCHING TO BE EVENLY SPACED THRU OUT NOT LESS THAN 8 NOR MORE THAN 12 STITCHES PER INCH ON SIDE ROWS OF STITCHING AS INDICATED. THERE SHALL BE NO BUNCHING OR CROWDING OF ZIG-ZAG STITCHES. STITCHING SHALL PASS THRU SUSPENSION LINE WITH AT LEAST TWO ROWS CATCHING LINE

EACH SUSPENSION LINE TO BE UNDER 20 lbs. TENSION WHILE MARKING.

THE TOTAL LINES MUST BE MARKED AS A GROUP AND NOT SEPARATELY- USE COLORED PENCILS FOR MARKING LINES.

TYPICAL ASSY. OF GORE WITHOUT SUSPENSION LINES ATTACHED

Figure 2–16.—The 28-foot, ripstop, nylon canopy. Continued.

chute canopies are available for training purposes. Men weighing 185 pounds or more are eligible for their use. The 32-foot canopy is not illustrated, as it is essentially the same as its 28-foot counterpart.

All shroud or suspension lines run continuously without splices, knots, or twists from connector link to connector link. This is illustrated in figures 2–15 and 2–16. Tensile strengths are not given here. Refer to appendix II for this information.

After studying the foregoing material on standard flat type canopies, the following items should be remembered:

1. Each gore is composed of four sections identified by the letters A, B, C, and D, starting from the bottom.
2. Diagonal seams run parallel to the warp thread in the cloth; the warp changing direction with each gore. These sections are cut at a 45° angle to the centerline of the gore. This is called BIAS CONSTRUCTION and provides the maximum strength and elasticity in the unit.
3. Radial and diagonal seams are double-lapped for security. The radial seams enclose the suspension lines in the channels produced by the stitching.
4. The skirt and vent hems are reinforced with 1-inch nylon webbing. Tubular nylon webbing is installed in the vent to help prevent a tear from completely separating the canopy, and nylon webbing is installed in the skirt hem for the same reason.
5. The vent ring must expand from 4 inches to 18 inches in diameter. This is the maximum vent opening under air pressure. The vent acts as a safety valve and aids in relieving high internal pressure within the inverted, cup-shaped, parachute at the moment of opening. In normal descent, the air, not relieved by the vent, spills out of the sides and creates a certain amount of oscillation. Without a vent, parachute openings at high speed could result in a severe rupture of the canopy.
6. The following is stenciled on the top center gore (section A of number 28 gore) in letters ½ inch high and approximately 12 inches from the bottom of the canopy:

NAVAIRFAC 602516–1
ORDER NO.
DATE OF MANUFACTURE AND SERIAL NO.
MANUFACTURER'S NAME OR TRADE MARK.

Stenciled on the diametrically opposite gore (section A of number 14 gore) is found the following:

DATE OF MANUFACTURE AND SERIAL NO.

These markings may vary slightly from lot to lot, but generally the information is the same.

7. All marking fluid used shall be in accordance with Specification AN–F–39. Specifications may change. In "looking up" a specification and not finding it listed in the numerical listing, the following steps are recommended (using AN–F–39 as an example):

a. Refer to the latest *List of Military Specifications and Standards* used by the Bureau of Aeronautics.

b. AN–F–39 was an Air Force-Navy Aeronautical Specification, and is no longer listed under the AN specifications.

c. If the title of the specification had been known, reference to the alphabetical listing could have been made before trying the numerical listing. For example, in the Specification AN–F–39, it is the "F" that gives the clue—FLUID, Parachute Marking. Under the alphabetical listing you will discover that a new specification is being used—MIL–F–6903 (MIL–F–6903 is referenced in the latest NAF blueprints), and Specification AN–F–39 is no longer listed.

d. Now, to make certain that this new specification is the accepted specification, refer to the list of cancelled or superseded specifications. Under the AN listing, you will discover that AN–F–39 has been superseded by MIL–F–6903.

e. When there are no references to a certain specification or when no title can be found, the chances are that the item has been discontinued. To locate information on very old specifications, one must employ a broader research technique in acquiring back numbers of the appropriate indexes.

8. All machine stitching, except zigzag, shall conform to

Type 301, Specification DDD–S–751, and not be less than 8 nor more than 11 stitches per inch.

9. Ends of all tape, webbing, and lines shall be seared to prevent fraying. No waxes shall be used.

10. For sewing diagonal seams, size "B" or "E" nylon thread may be used. Use size "E" nylon thread for all other seams, zigzag stitching, and repairs.

11. Removable connector links provide a quick attachment of the canopy and suspension lines to the harness.

CONICAL CANOPY.—Figure 2–17 illustrates the conical canopy designed like the 28-foot flat canopy to absorb opening shocks in excess of 8,000 pounds. A parachute rigged with this canopy is reduced in bulk, offers greater stability and a

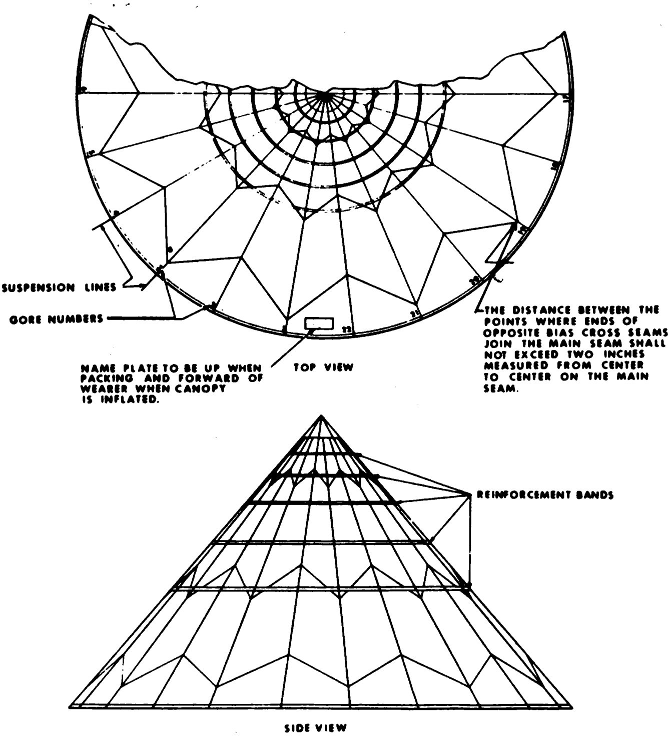

SUSPENSION LINES
GORE NUMBERS
NAME PLATE TO BE UP WHEN PACKING AND FORWARD OF WEARER WHEN CANOPY IS INFLATED.
TOP VIEW
THE DISTANCE BETWEEN THE POINTS WHERE ENDS OF OPPOSITE BIAS CROSS SEAMS JOIN THE MAIN SEAM SHALL NOT EXCEED TWO INCHES MEASURED FROM CENTER TO CENTER ON THE MAIN SEAM.
REINFORCEMENT BANDS
SIDE VIEW

Figure 2–17.—Conical canopy, 26-foot 22-gore.

faster opening, and has a slightly higher average rate of descent (22 feet per second).

Note the construction differences:

1. Shape.
2. Suspension lines are anchored to the canopy at the skirt and are not continuous from link to link. This reduces the bulkiness of the parachute.
3. Reinforcing bands of tape are located around the circumference starting at the top of section No. 2.
4. The conical canopy does not have a vent collar, but does have a vent cover.
5. There are 22 gores, the joining of which requires fewer seams and is less bulky.
6. The strength and the stability of the parachute are increased; but the rate of descent has been sacrificed to a certain degree for the apparent emphasis on less bulk.

Suspension Lines

The suspension lines form a net or skeleton for the canopy and absorb a portion of the shock load.

Suspension lines are marked and cut as a group under a 20-pound tension since all lines must be equal in length. It

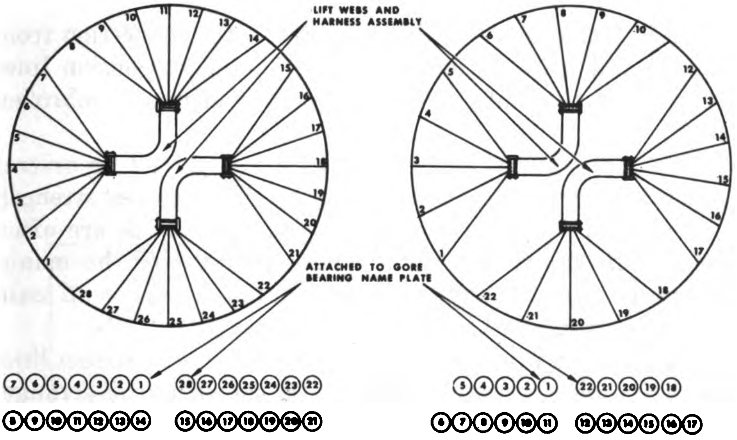


Figure 2–18.—Method of attaching suspension lines to connector links.

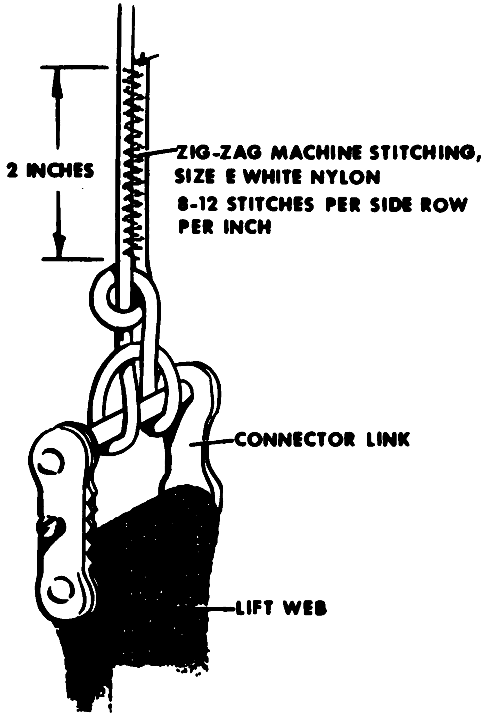

2 INCHES
ZIG-ZAG MACHINE STITCHING, SIZE E WHITE NYLON
8-12 STITCHES PER SIDE ROW PER INCH
CONNECTOR LINK
LIFT WEB

Figure 2–19.—Closeup of suspension lines at the link.

takes 75 feet 4 inches of line to complete the connection from link to link on a 28-foot canopy. The 28 suspension lines counted at the links are actually 14 continuous unbroken lines.

The sleeve is a loosely woven covering protecting several inner cords or strands called the CORE. The greatest strength comes from the inner cords. One or more cords are often colored in accordance with a code to identify the manufacturer. Type III nylon suspension line is used on all main canopies and on the vane type pilot chute.

Figure 2–18 illustrates the attachment of suspension lines to removable connector links. Also shown is the arrangement of the suspension lines on the 26-foot 22-gore canopy. The 28 suspension lines are distributed in four groups of seven lines each and each group of lines is secured to a connector link as shown in figure 2–19.

To prevent the canopy (28-foot) from slipping along the suspension lines, each line is anchored by zigzag stitching at several points to the radial seams through which it passes. One-half inch of slack is allowed in the vicinity of the skirt between the zigzag sewing points to relieve the strain during opening shock. This is necessary as the suspension lines have a greater percentage of elongation than the canopy fabric.

Harness

The purpose of the harness is to form a sling or swing in which the wearer may sit without danger of separation from the parachute.

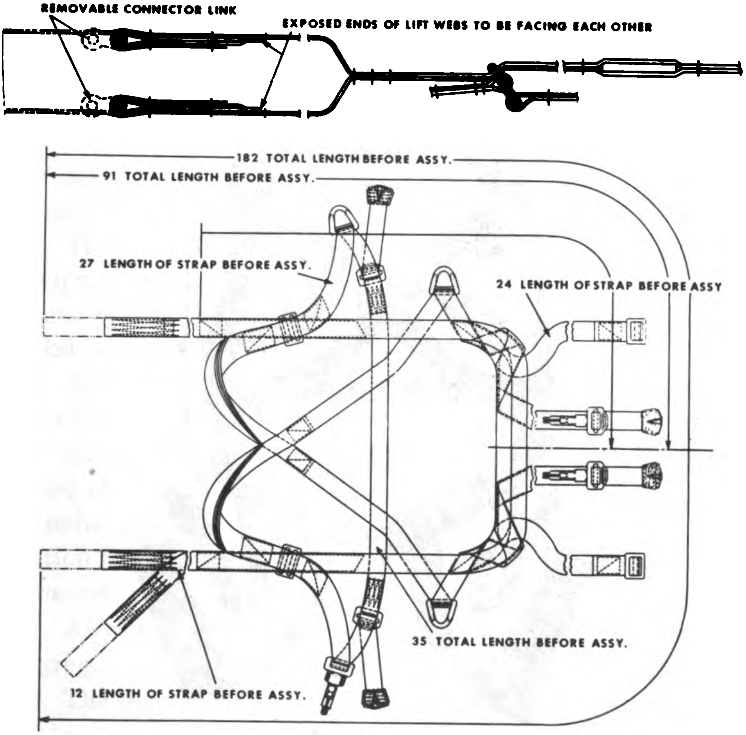

REMOVABLE CONNECTOR LINK
EXPOSED ENDS OF LIFT WEBS TO BE FACING EACH OTHER
182 TOTAL LENGTH BEFORE ASSY.
91 TOTAL LENGTH BEFORE ASSY.
27 LENGTH OF STRAP BEFORE ASSY.
24 LENGTH OF STRAP BEFORE ASSY
35 TOTAL LENGTH BEFORE ASSY.
12 LENGTH OF STRAP BEFORE ASSY.

Figure 2–20.—Seat type harness.

All Navy parachute harnesses are the quick fit type, and are easily adjusted by the individual wearer. Figure 2–20 illustrates the seat type harness.

This harness like all other harnesses is available in an oversize model. The oversize model is not illustrated. The dimensions in inches are listed below:

	NS3–R	*NS3–O*
End of sling reinforcing strap	1¾ x 12	1¾ x 12
Life raft retainer strap	1¾ x 24	1¾ x 24
Adjusting strap	1¾ x 27	1¾ x 38
Back strap	1¾ x 35	1¾ x 36
Leg and body strap	1¾ x 100	1¾ x 117
Sling strap	1¾ x 184	1¾ x 196

A soft weave nylon webbing is in use as the older hard webbing stock is approaching depletion, thus ending one of

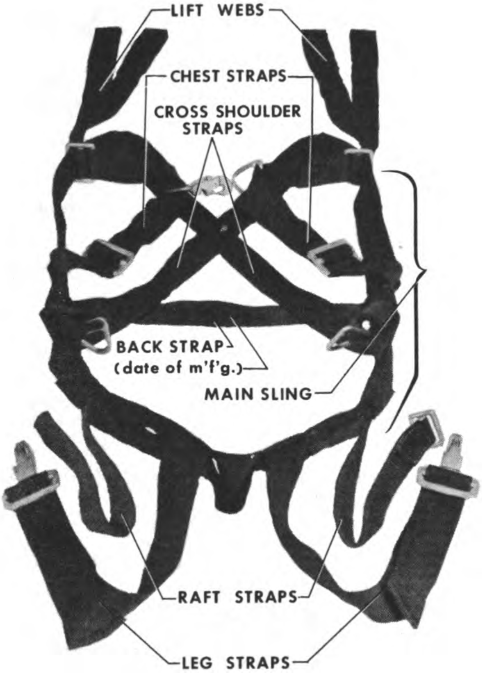


Figure 2–21.—Back type harness.

the major complaints against the uncomfortable nylon harness. This new soft webbing conforms with the General Textile Mills, Style 322A.

Figure 2–21 illustrates the back type harness which is very similar to the seat type.

The differences are purely dimensional and are in the leg and body straps, and main sling.

Figure 2–22 illustrates the chest type harness. This harness is the only one adaptable to the quick attachable chest parachute. The lift web assembly (fig. 2–23) is secured to the canopy by suspension lines in the same manner as the lift webs of a fixed type harness. The pack is attached to the harness by using a positive upward motion and engaging the connector snaps of the lift webs with the connector links of the harness.

The cross connector or safety strap of the lift web assembly is a very important item. It prevents the collapse of the canopy should only one connection be made.

From the above discussion of harness and the types of harness, the following facts are summarized:

1. The date of manufacture, month and year, should be stamped with marking fluid (Specification MIL–F–6903) in letters ½ inch high on either the inside of the horizontal backstrap or on the inside of the sling.
2. All harness snaps are to be assembled so that the open side of the snap is toward the body when worn.
3. Unless otherwise specified, all machine stitching is to be 6-cord olive drab nylon with not less than 4 nor more than 6 stitches per inch (spi), and conforming to Federal Specification DDD–S–751, Type 301. Ends of all stitching should be backstitched a distance of not less than ½ inch.
4. All exposed ends of webbing should be seared to prevent fraying.
5. The snaps used on both leg straps differ from those used on the chest strap. Quick fit adapters are employed on the harness. Both of the upper leg strap extensions carry tri-

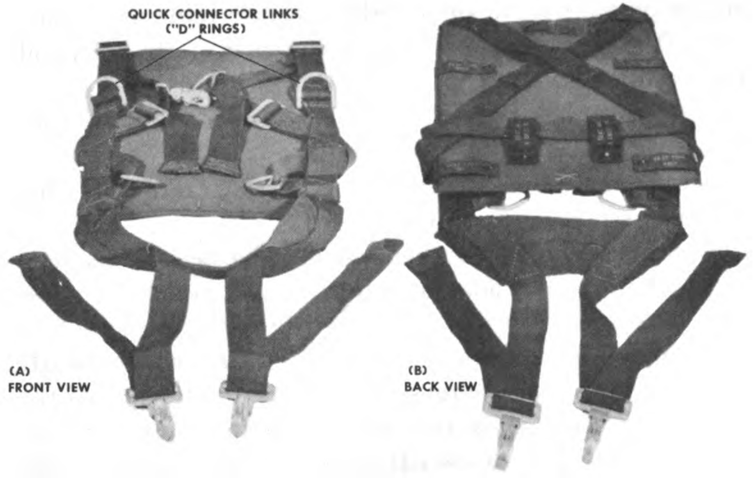


Figure 2–22.—Chest type harness.

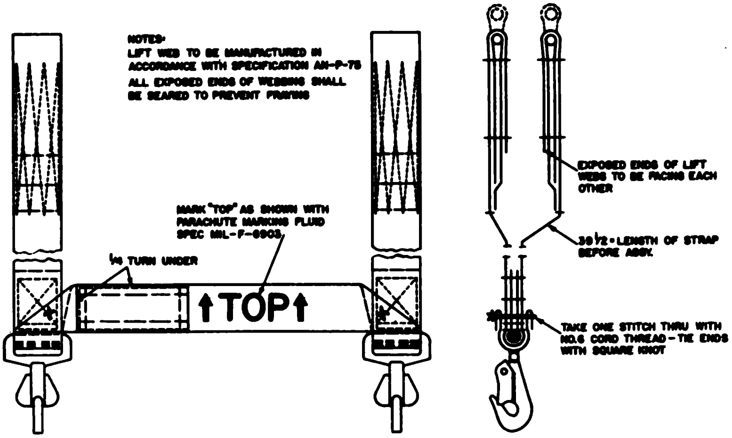

NOTES:
LIFT WEB TO BE MANUFACTURED IN ACCORDANCE WITH SPECIFICATION AN-P-75
ALL EXPOSED ENDS OF WEBBING SHALL BE SEARED TO PREVENT FRAYING
MARK "TOP" AS SHOWN WITH PARACHUTE MARKING FLUID SPEC MIL-F-6903
¼ TURN UNDER
TOP
EXPOSED ENDS OF LIFT WEBS TO BE FACING EACH OTHER
39½ = LENGTH OF STRAP BEFORE ASSY.
TAKE ONE STITCH THRU WITH NO.6 CORD THREAD - TIE ENDS WITH SQUARE KNOT

Figure 2–23.—Lift web assembly.

angle links. Triangle links were formerly called V-rings.

6. The troop type harness is a combination harness adaptable to the quick attachable NT4 and the NT4–R. The parachute carries the harness designation and in this case it is an "R" or regular size harness. This harness has not been il-

lustrated, as other illustrations have sufficiently covered all necessary nomenclature, design, and material features.

7. All harnesses are dyed olive drab.

The Parachute Pack

The purpose of the parachute pack is to house and protect the pilot chute, canopy, and suspension lines.

Figure 2–24 illustrates the seat type parachute pack designed to be used with the 28-foot, ripstop, nylon canopy.

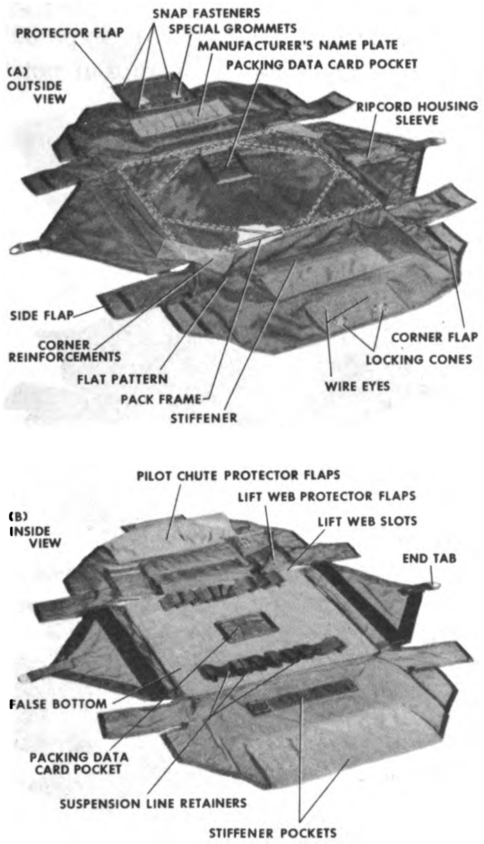


Figure 2–24.—Seat type pack.

Figures 2–25, 2–26, 2–27, and 2–28 illustrate the other packs employed. Careful study will show the differences.

In regard to construction of the container, the following items are to be noted:

1. The outside covering of the pack, referred to as –16 (seat pack) on the blueprint, is cut in one piece on a bias at 45° to the centerline. This provides the elasticity necessary for the terriffic beating to which the unit is subjected in packing and in normal use.

2. All machine stitching used is accomplished with size "E," olive drab, nylon thread, 6 to 10 stitches per inch, conforming to Specification DDD–S–751, Type 301. Ends of all stitching are backstitched a distance of not less than ½ inch.

3. Ends of webbing and tape are seared to prevent fraying.

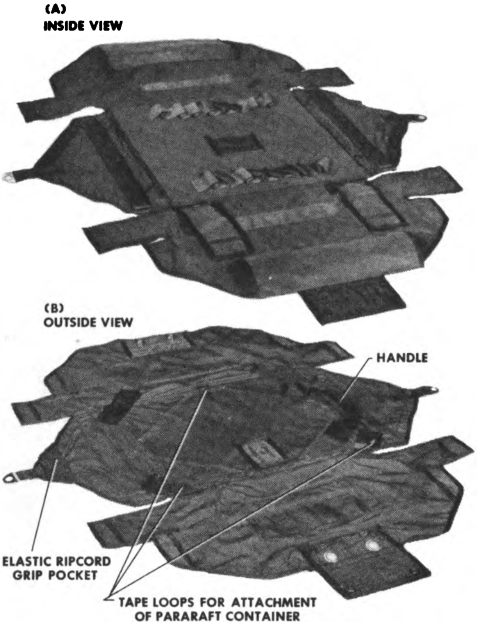

(A)
INSIDE VIEW
(B)
OUTSIDE VIEW
HANDLE
ELASTIC RIPCORD GRIP POCKET
TAPE LOOPS FOR ATTACHMENT OF PARARAFT CONTAINER

Figure 2–25.—Chest pack.

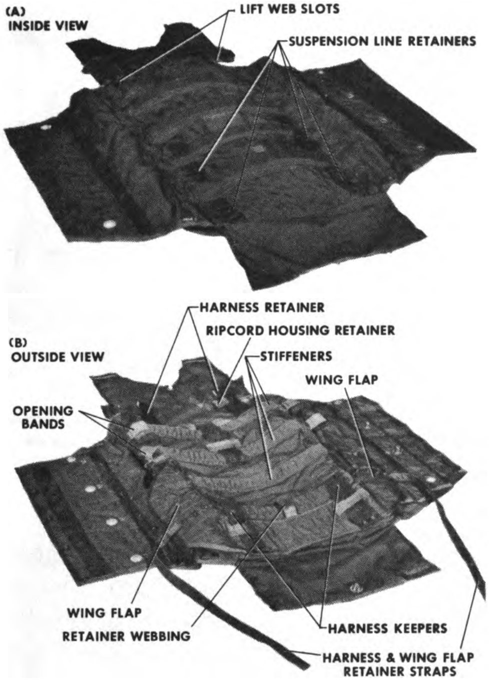


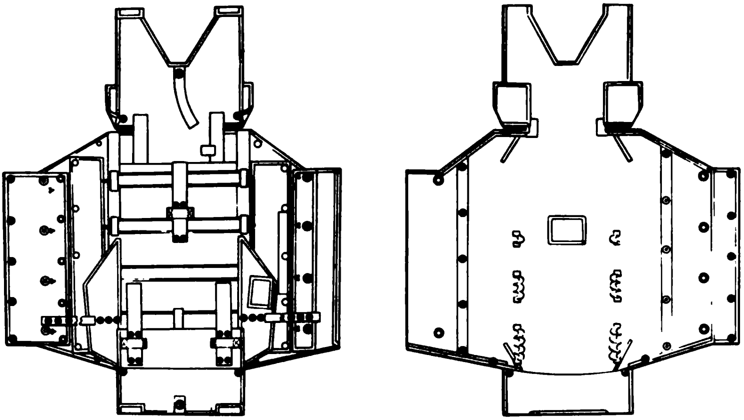
Figure 2–26.—Back pack.

4. The cloth used in the outside of the pack is known as type II, olive drab nylon. It conforms to the requirements of Specification MIL–C–7219, (AER).

Many interesting facts about materials used in this work can be found in the Navy, Air Force, Military, and Federal Specifications. Visit your local Technical Publication Library when you need certain specific information, or go there simply to increase your knowledge.

Ripcord

The ripcord is a manual releasing device. The ripcord pins, when inserted in the locking cones of the pack, hold the pack in a closed position. In testing, a pull not in excess of 22 pounds should extract the pins out of the cones. A



(A) OUTSIDE VIEW Note similarity to BACK PACK, Fig. 2-26 (B) INSIDE VIEW

Figure 2–27.—Troop packs.

jumper would use a much stronger pull. The ripcord assembly is composed of a grip or hand pull, a length of cable, and a number of swaged pins. This has been the standard releasing device for the past thirty years. The help of spring bands is necessary to pull the sides and ends of the pack out of the way. These opening bands are located either on the outside of the pack or enclosed between the fabric layers of the pack. For the past ten years efforts have been made to design a successful smooth pack that completely eliminates any outside obstructions. The chain lock pack meets these requirements. This parachute is a back type design and employs a strong and durable chain lock as the releasing device. (See fig. 2–29.)

Figure 2–30 illustrates the standard releasing device used with the seat type parachute.

Figure 2–31 illustrates the two general shapes of ripcord grips used with Navy type parachutes.

Figure 2–32 illustrates the types of ripcords used with the seat, back (NB3 and NB4 types), chest, and training type parachutes.

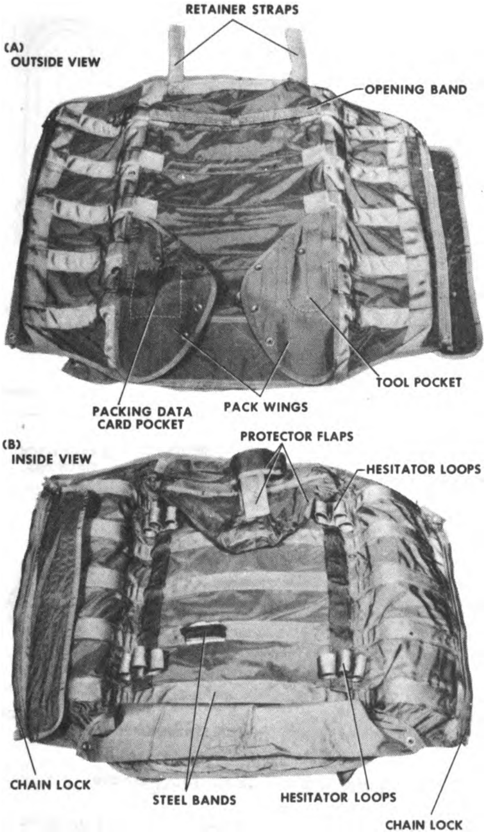


Figure 2–28.—Chain lock back pack.

In conclusion:

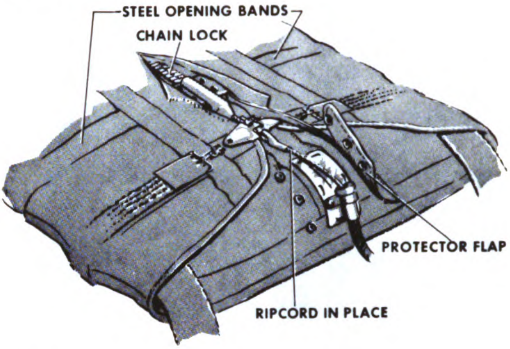
1. Ripcord assemblies are proof-loaded to withstand a 300-pound pull.

2. Ripcord pins conform with AN drawing number 6568–1, are trimmed to size, and polished with 0 emery cloth or other approved methods.

3. Ripcord cables are manufactured from $\frac{3}{32}$-inch corrosion resistant steel.

4. Hand pulls or grips are manufactured from welded steel tubing, cadmium plated for protection.

(A)
CHAIN LOCK PRIOR TO RELEASE



(B)
CHAIN LOCK RELEASED

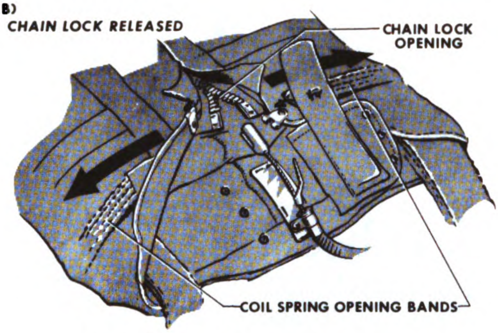


Figure 2–29.—Chain lock release.

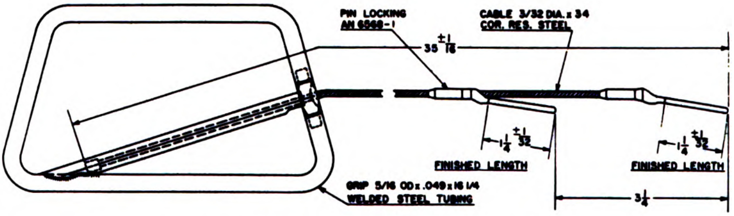
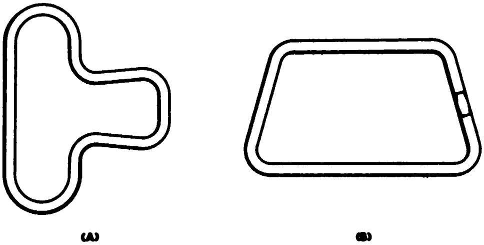


Figure 2–30.—Ripcord parachute, extensible.

5. The cone spacing on the pack must correspond to the pin spacing of the ripcord. This spacing is standardized for each type of parachute.

6. Ripcord pins, spacers, and ball retainers are swaged on the cable under pressure and form secure fittings.



USED WITH:
CHEST TYPE PARACHUTE
TRAINING BACK TYPE PARACHUTE

USED WITH:
SEAT TYPE PARACHUTE
BACK TYPE PARACHUTE

Figure 2–31.—Ripcord grip shapes.

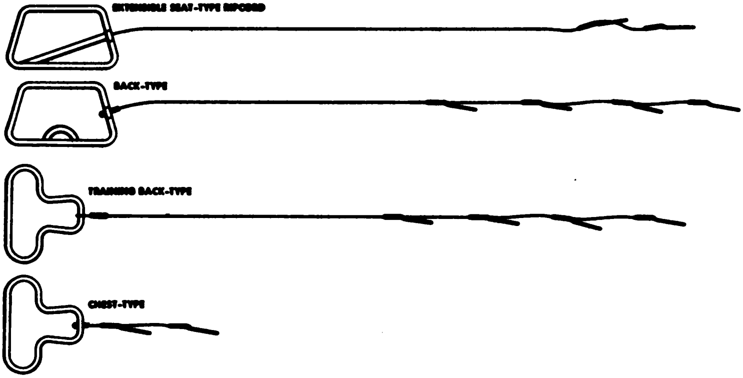


Figure 2–32.—Ripcords.

7. The extensible ripcord used with the seat type parachute makes changing to or from the pararaft easier by eliminating the need of changing to longer or shorter ripcord housings.

Ripcord Housings

Figure 2–33, view (A), illustrates the extensible ripcord housing, and the type which forms an integral part of the ripcord assembly used on the NB4 type parachute is shown in view (B).

Notes:

1. The length of the extensible housing when elongated to its fullest extent will measure 28¼ inches under 5 pounds

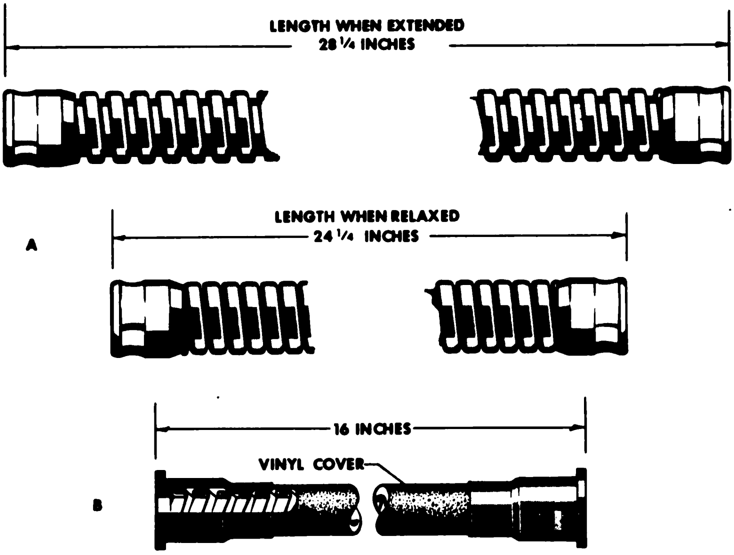


Figure 2–33.—Extensible ripcord housing. (A) Extensible housing; (B) NB4 type housing.

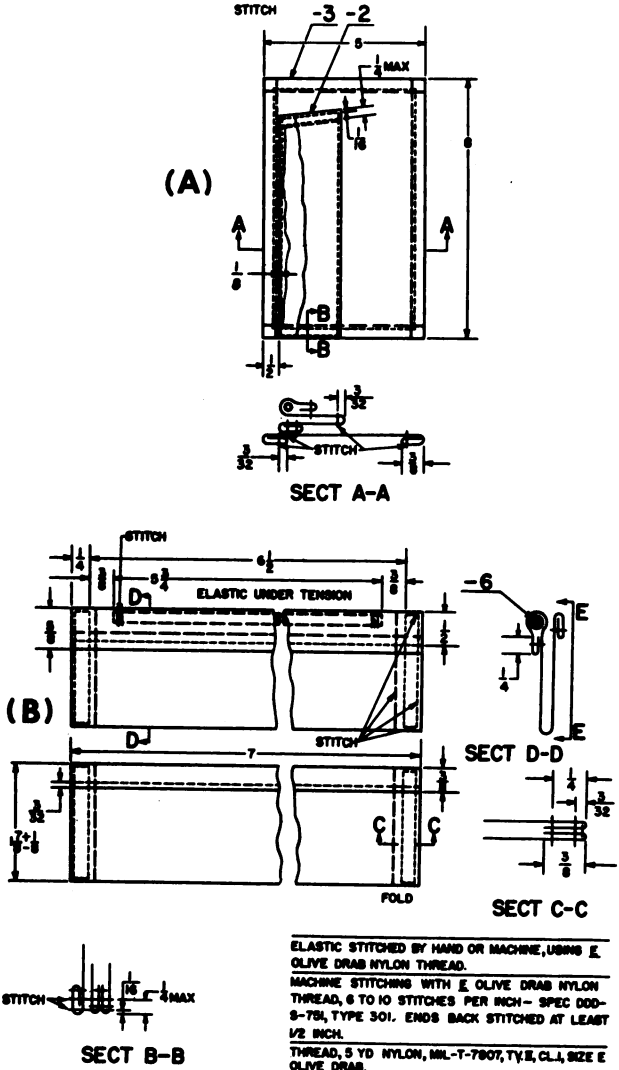
tension. The length, when relaxed to its normal free position, will not exceed 24¼ inches.

2. The ferrules located on the ends of all housings are identical in design.
3. The tubing is corrosion resistant steel.
4. NB3 type parachute uses a 21-inch housing.
5. NB4 type housing is covered with a vinyl plastic.

Ripcord Grip Pockets

The purpose of the pocket is to hold the grip securely to the harness, or in the case of the chest parachute, to the pack.

Figure 2–34 illustrates the ripcord grip pockets used on seat and back type parachutes and lists the material necessary for manufacture of these items. The assembly shown in (A) is used in conjunction with the NB3 type parachute as indicated on the rigging diagram in chapter 4. The sub-



ELASTIC STITCHED BY HAND OR MACHINE, USING E OLIVE DRAB NYLON THREAD.

MACHINE STITCHING WITH E OLIVE DRAB NYLON THREAD, 6 TO 10 STITCHES PER INCH— SPEC DDD-S-751, TYPE 301. ENDS BACK STITCHED AT LEAST 1/2 INCH.

THREAD, 5 YD NYLON, MIL-T-7807, TY.II, CL.I, SIZE E OLIVE DRAB.

ELASTIC, 3/16 DIA.x 4-1/2 MIL-C-5650

PANEL-POCKET, 5-1/2x7-3/4 NYLON, MIL-C-7219 (ASG) TY.III GREEN OR SAGE GREEN

SLIDE LOOP, 6-1/2x9-1/2 NYLON, MIL-C-7219 (ASG) TY.III GREEN OR SAGE GREEN

Figure 2–34.—Ripcord grip pockets. (A) NB3 type; and (B) NS3 type.

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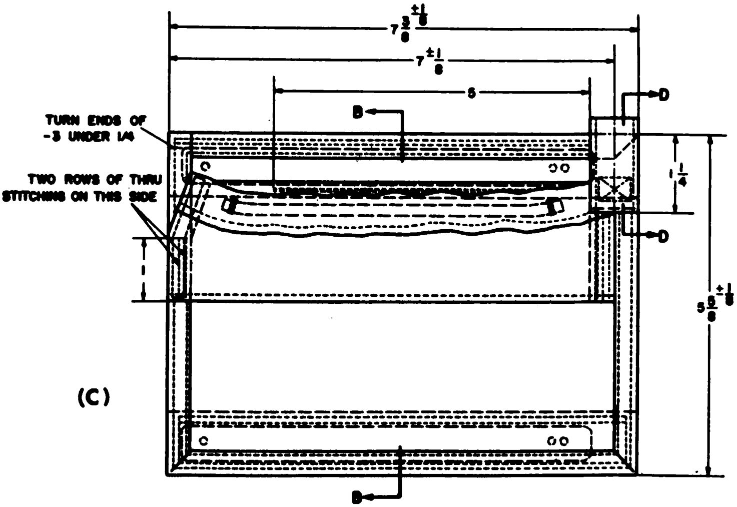

7 3/8 ±1/8
7 ±1/8
5
B
D
TURN ENDS OF -3 UNDER 1/4
TWO ROWS OF THRU STITCHING ON THIS SIDE
1 1/4
D
5 5/8 ±1/8
(C)
B

Figure 2–34.—(C) Ripcord grip pocket, NB4 type.

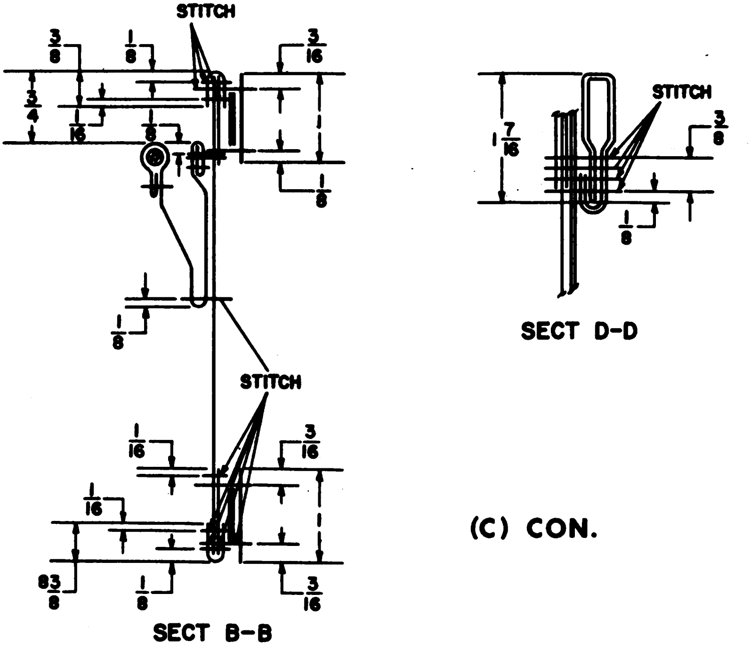


Figure 2–34.—(C) Continued.

assembly shown in (B) is used on the seat type parachute also indicated on the applicable rigging diagram in chapter 4. The assembly shown in (C) is used on NB4 type parachute.

The other grip pockets, hand pull retainers, or elastic-rip handles (as they are termed in NAF blueprints) for the chest and training type parachutes are not shown because of their simplicity in construction. An elastic-rip handle for the service chest type parachute is manufactured from a length of elastic webbing measuring ⅛ inch thick by 1½ inches wide and 6 inches long.

Seat Cushions and Back Pads

Seat cushions provide comfort for the wearer and are located as a cushion between the wearer and the parachute

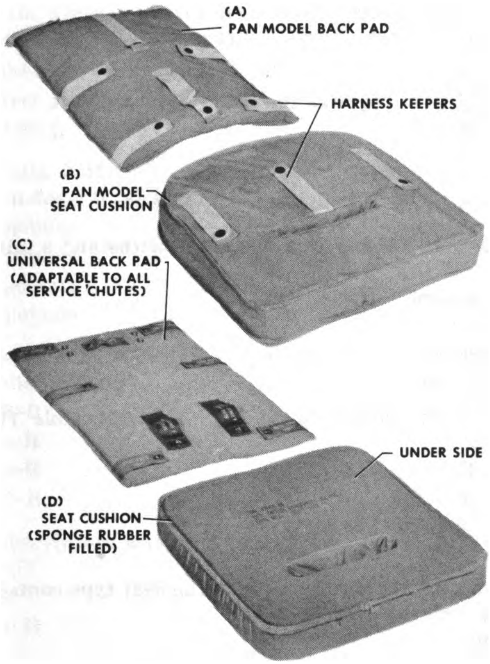


Figure 2–35.—Seat cushions and back pads.

pack. When the seat and back type parachutes are rigged with the pararaft kit, the cushions are tacked to the pararaft kit container as outlined in chapter 4.

Back pads retain specific harness webbing straps, through the use of keepers, and also provide comfort and support for the back. The back pad further acts as a perspiration barrier when rigged to back type parachutes. (See fig. 2–35.)

QUIZ

1. Ripcord cables are manufactured of
    a. corrosion resistant piano wire
    b. monel steel wire
    c. corrosion resistant brass wire
    d. corrosion resistant steel

2. Which parachute requires the longest ripcord?
    a. NS3–R
    b. NC3–O
    c. NB3–O
    d. NT4–R

3. Ripcord assemblies are proof-loaded to withstand a minimum pull of
    a. 150 pounds
    b. 200 pounds
    c. 300 pounds
    d. 450 pounds

4. Which type of parachute employs the extensible ripcord and housing?
    a. NC3–R
    b. NS3–R
    c. NB3–O
    d. NT4–O

5. Which container is most similar to the seat type container?
    a. Back
    b. Chest
    c. Troop
    d. Chain lock

6. When testing, what is the maximum pull allowed to operate the releasing device of the parachute pack?
   a. 10 pounds
   b. 18 pounds
   c. 22 pounds
   d. 28 pounds

7. On the NC3–R, what safety feature is employed in the event only one connector snap is hooked up?
   a. Lift webs
   b. Cross connector strap
   c. Chest strap
   d. Butterfly tacking

8. How are the ends of webbings and tapes prepared to prevent fraying?
   a. Waxed
   b. Taped
   c. Sewed
   d. Seared

9. What is the average rate of descent of a conical type parachute?
   a. 16 feet per second
   b. 18 feet per second
   c. 20 feet per second
   d. 22 feet per second

10. To maintain uniformity of length, suspension lines are measured and cut under a tension of
    a. 12 pounds
    b. 18 pounds
    c. 22 pounds
    d. 20 pounds

11. Which parachute is designed to allow the crew freedom of movement while in flight?
    a. NC3–R
    b. NS3–R
    c. NB3–R
    d. NT3–R

12. What abbreviation was used to designate the first Navy seat type parachute?
    a. NSP
    b. NS1–R
    c. SS
    d. NS

13. Which index sheet would show component parts and drawing numbers of the seat type parachute?
    a. NAP1 00–500
    b. AN 205804
    c. NAF 401255
    d. NAF 1055

14. Which is NOT considered in the category of service type parachutes?
    a. NS3–R
    b. NC3–R
    c. NB3–O
    d. NT4–O

15. Which is one of the five main parts of the service parachute?
    a. Suspension lines
    b. Canopy panel
    c. Ripcord
    d. Main sling

16. What is the index number for Navy type parachutes?
    a. 1155
    b. 1055
    c. 301
    d. NS3–R

17. The manufacturer's name or nameplate is located on which gore?
    a. No. 1
    b. No. 14
    c. No. 26
    d. No. 28

18. All straight machine stitching in the parachute conforms to type
    a. B
    b. E
    c. 301
    d. 304

19. A canopy constructed so that the warp and filler threads of the cloth run 45° to the centerline of the gore is called
    a. straight construction
    b. bias construction
    c. radial construction
    d. diagonal construction

20. What is the maximum expansion of the vent?
    a. 4 inches
    b. 12 inches.
    c. 18 inches
    d. 22 inches

21. The conical type canopy contains
    a. 4 gores
    b. 22 gores
    c. 26 gores
    d. 28 gores

22. When the canopy is inflated which section is topmost?
    a. A
    b. B
    c. C
    d. D

23. Which type parachute is currently used in VA type aircraft?
    a. NS3–R
    b. NC3–R
    c. NB3–R
    d. NR3–R

24. Who grants permission for special parachute jumps?
    a. Commanding Officer
    b. CNO
    c. Parachute Officer
    d. BuPers

25. Which type of parachute was first adopted in the naval service?
    a. Quick attachable chest
    b. Quick attachable seat
    c. Seat
    d. Back

26. In what era was the quick fit harness adopted?
    a. 1924 at Wright Field
    b. Just before World War II
    c. During World War II
    d. After World War II

CHAPTER 3

PARACHUTE INSPECTION

Parachute inspections must be carefully conducted to insure comfort, security, rapid positive functioning, and air worthiness of the entire assembly.

The inspection must insure comfort. Pilots and aircrewmen, with the exception of some transport crews, are required by regulations to wear either a harness or a complete parachute while in flight. Improper adjustment or rigging can cause a great amount of discomfort and bring on fatigue.

The various subassemblies of a parachute must be securely rigged so that one part will not break or tear away from another and thus jeopardize the entire unit. At the moment of the opening shock everything must hold together.

Trouble does not respect any altitude. Engine or structural failure can suddenly occur at 600 feet as well as at 6,000 feet. To insure a safe bail out at low altitude the parachute must open and open without delay.

Last of all, can the parachute take it? Will it stand up under long periods of service use? These are the vital questions, and the answers lie in the hands of the Parachute Rigger and how well he performs his duties.

FACTORS AFFECTING MALFUNCTIONS

Before inspecting a parachute you must know what to look for. Even though familiar with parachute construction, you may not find structural flaws and other details that cause malfunctioning unless you look specifically for certain imperfections.

The detection of the following imperfections depends on the thoroughness applied to the inspection BEFORE the parachute is packed for service.

WEAR.—When you look for wear in a parachute assembly you look for chafing, tears, and bent or broken units. The observance of these things certainly isn't difficult nor is the corrective action that follows. The important thing besides correcting the trouble is to consider its source. What caused the damage? Is the damage normal and if not, how was it inflicted? Is additional training of personnel necessary? Only upon competent authority can modification of either the parachute or aircraft bring about this correction. Don't lose sight of the possibilities for improvement.

STAINS AND DETERIORATION.—Look for areas which may have come in contact with harmful foreign substances such as acid, oil, salt water, or ammonia. Stains brought on by milder substances are a common indication of deterioration. Stains generally appear as a discoloration or blemish in the material, usually distinguished by a circular or round ring. Salt water stains are characterized by the appearance of a white crystalline substance on the surface. Oil stains are recognizable by their brown-to-black color, and the oily feeling when rubbed between the fingers. Acid stains on white material appear as a greyish powdery ash. On darker materials, it tends to bleach. On all materials it causes deterioration.

An ugly stain is easily seen in a piece of fabric and usually the first thought is that the appearance of the item has been ruined. With clothes, that is true; but a stained parachute can be a threat to safety and steps must be taken to detect, neutralize, and correct the trouble before deterioration really starts.

Deterioration impairs the usefulness of any material. A suspension line must strength test at a minimum of 550 pounds, but once deterioration enters the picture we can expect a weaker line.

DISCONTINUITY OF SUSPENSION LINES.—Is each unit of the assembly in its proper position? Are all of the suspension lines in correct rotation at the links and through the canopy of the 28-foot type?

Noncompliance with current directives.—Is the parachute up to date? Have the latest modifications and improvements been incorporated in the design? Do not tolerate any "wild cat" modification; all justifiable local changes must first be approved by proper authority.

Incompleteness.—Is the parachute complete? Regardless of how small and seemingly insignificant a missing item may appear, it is always possible that its omission will affect the operation of the parachute. An incomplete assembly could cause a complete failure.

Manufacturer's errors.—If you've ever purchased a new car, you can appreciate the point to be made here. Newness is not necessarily a sign of perfection or even acceptability. Many people are fooled by a bright, new, shining object. Before packing new parachutes for service, make the required inspection of all the assemblies.

Flaws.—Small flaws occasionally found in fabric will not affect the strength or operation of the parachute. The parachute is constructed from the very best grade of materials obtainable which have been subjected to all kinds of tests to prove their superiority. When in doubt about the strength of an item, due to harmful flaws in the material or for any other reason, the best procedure to follow is to turn the parachute in for test and overhaul.

INSPECTION INTERVAL

Parachutes are to be given a daily sight inspection, a thorough table inspection at least once every 60 days and once every 10 days in accordance with current directives for specific cases.

Daily inspection.—All parachutes in service shall be given a daily sight inspection. This inspection, which covers the external appendages of the parachute, can be completed in a short time. This inspection should be made prior to issue and should not interfere with the flight schedule. Any discrepancies of a minor nature must be remedied immediately, while those involving more work should be set aside for dispositioning and overhaul. The following operations are to be performed in making a daily inspection:

1. Check the safety thread on the locking pin. If broken, replace it and find out why it was broken. Check the position of the ripcord pocket and housing.
2. Check the locking cones and grommets for damage and the ripcord pins for bends or breaks.
3. Check the security of the ripcord protector flaps.
4. Check the container for wear and stains. Is the canopy showing? Battery acid is quite often picked up from aircraft bucket seats. These seats should be periodically washed with a neutralizing agent, rinsed with clear water, and dried thoroughly as will be explained later. Watch out for dampness especially after the aircraft have been away from the strip or base for a number of days.
5. Check the pack opening bands for condition and security to the pack.
6. Check the security of the ripcord grip and see that it will come out of the pocket. Check the security of the cable to the grip. A loosely fitting ripcord grip pocket is dangerous.
7. See that the ripcord housing is undamaged and securely fastened.
8. Check the harness for wear, stains, twists, and security of the lift webs where they enter the pack.
9. Check the harness fittings for damage and corrosion. The snaps should work freely but with reasonable tension.
10. Check the back pad and cushion and see that the KEEPERS are SECURING these items to the harness.
11. When the oxygen bail-out cylinder is used, check the cylinder gage for a full charge (1,800–2,200 p. s. i.). See that the locking pin is removed and the hose line is in good condition.

SIXTY-DAY INSPECTION.—The 60-day inspection involves a complete check on the parachute. This inspection is most efficiently made prior to packing which is also on a 60-day interval basis. Some prefer to hold the inspection just before hanging the parachutes in the drying locker. Then they are free to pack the next day. Do that which is convenient and SAFE. The 60-day inspection is also given parachutes following a descent.

TROPICAL INSPECTION.—In tropical zones, inspection and packing are performed more often due to the higher humidity experienced in this zone. The temperate zones are no exceptions to the 60-day yardstick if, during a rainy season, you believe it necessary to repack more often than every 60 days. Set your own schedule. This holds true aboard ship or ashore. Remember that you enter the tropics at approximately 24 degrees north or south of the Equator.

The Aviation Supply Office Catalog lists the "shelf life" for storage of "canned" parachutes as being 36 months. After 36 months in storage the parachutes are shipped to the nearest overhaul station for inspection, drying, and repackaging in specially designed metal containers. This item is carried under Section 8305 as R83 equipment.

SURVEY

The service life of the parachute is 7 years from the date of manufacture, and the parachute is withdrawn at the end of the month that is stamped on the canopy. Parachutes cannot be surveyed by aviation units unless lost or completely destroyed. Parachutes found unsuitable for use prior to the expiration of service life and those that have reached the striking date shall be turned in to the nearest supply activity for forwarding by the Aviation Supply Officer to the Naval Air Station, Alameda, California, or the Naval Aircraft Factory, Philadelphia, Pennsylvania, whichever is nearer, for disposition.

The squadron Parachute Rigger works through his Fleet Aircraft Service Squadron. A FASRon exists to supplement the squadrons. It is the central supporting activity equipped to perform as a limited overhaul and repair shop.

The major repair stations listed in NavAer 13–5–501, *Parachute Manual*, are the only authorized activities to carry out major repairs.

INSPECTION TABLE

The inspection table and the packing table are one and the same. Naval air station and Fleet Aircraft Service Squadron parachute lofts have little need for the illuminated frosted glass top table. The illuminated inspection table

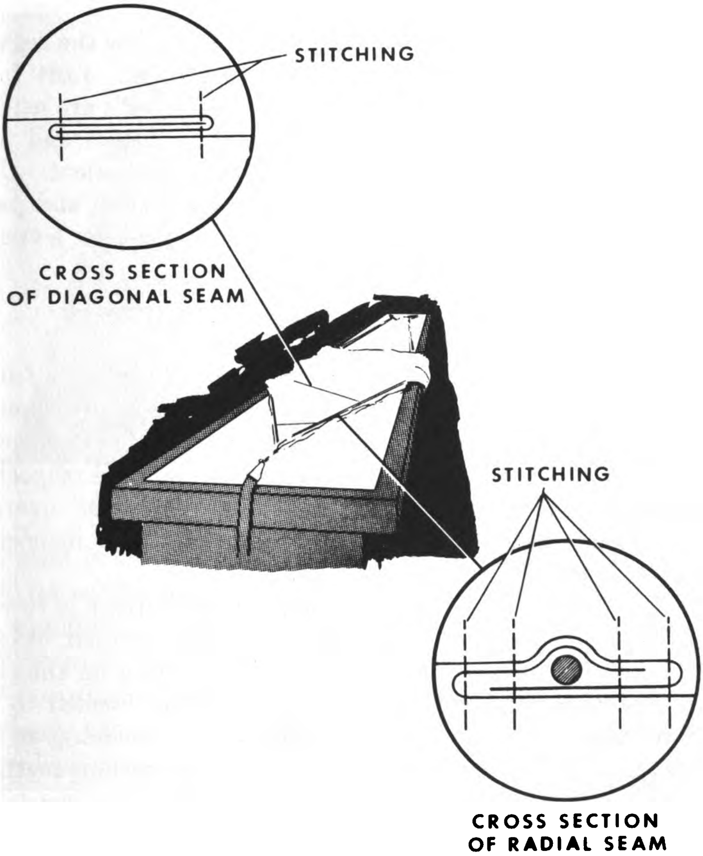


Figure 3–1.—Illuminated inspection table.

(fig. 3–1) is used mainly by manufacturers and major repair stations where the canopy stitching must be checked to see that it has passed through the required number of folds in the radial and diagonal seams.

Four rows of stitching must pass through the entire length of each radial seam for perfect security and two rows for the diagonal seams. Light directed up through the canopy will show every imperfection in the seam folds and the stitching that missed the seam folds. Every inch of every seam is examined by the manufacturer to insure the security of his product.

First line carriers and seaplane tenders utilize the regular packing table for all kinds of parachute work. Loft facilities aboard CVE's 105 class, CVL's, and AVP's are usually nonexistent. Oftentimes you will have to inspect and pack the parachutes on messhall tables or their equivalent. This condition may require scheduling your inspection and packing between meals, working at night, or waiting for a chance to work on the beach.

INSPECTION PROCEDURES

When searching for defective or damaged parts, the fullest advantage should be taken of any knowledge or information of the conditions under which the parachute has been used.

One of the most important physical items in the inspection procedure is cleanliness. Cleanliness cannot be overemphasized. Before laying a parachute out on the inspection table, be sure the surface is clean.

Lay the parachute out so that the peak (apex) is toward the head of the table. Engage the links of the lift webs in the holding device. Apply tension by pulling on the peak of the parachute with a length of webbing hooked to the pilot chute connector cord and fasten the webbing to the table. Figure 3–2 illustrates one of the many table methods of placing the parachute under tension for inspection and packing purposes.

Inspect each of the five major parts of the parachute in sequence and all subassemblies of each part, beginning with

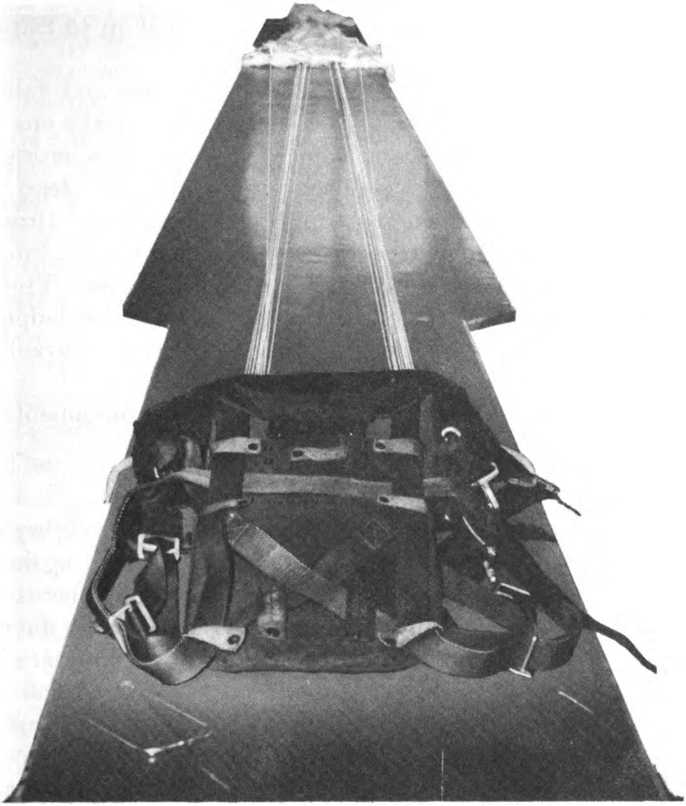


Figure 3–2.—Parachute ready for inspection.

the pilot chute and working down to the pack or container.

A parachute must be thoroughly inspected regardless of its apparent condition. The time required to examine a complete parachute varies with the type and age of the equipment available, but the time devoted is of secondary importance when it is borne in mind that the life of an airman may depend upon close and conscientious work.

To conduct a thorough inspection one must be familiar with all of the technical publications relating to the parachute. Before commencing an inspection, check the striking date stenciled on the canopy of the parachute. If the parachute has reached its strike date, turn it in to Supply and draw another one.

The majority of your work with parachutes and fabrics will be with nylon materials. Learn the material's characteristics. A thorough knowledge of this subject is necessary for you to successfully conduct an inspection. Read the specifications for nylon parachute cloth, webbing, threads and cords, etc. Don't be satisfied with a superficial knowledge of the fabrics you handle day in and day out. You, as a Parachute Rigger, should have a sufficient knowledge of fabrics in order to conduct an intelligent parachute inspection.

The inspection procedure for the various components of the parachute follows.

Pilot Chute

A pilot chute is designed to spring out of the pack beyond the negative pressure area created by the free-falling body. To accomplish this, a positive action spring is installed in the canopy of the pilot chute. The two most important factors affecting the successful operation of the pilot chute are the security of the pilot chute to the suspension lines at the peak of the main canopy and the unrestricted action of its spring.

Check the security of the pilot chute to the apex of the main canopy. Are the knots secured tightly in place? Are they the proper type, and is the bitter end of each knot long enough to prevent slippage? Check the length and condition of the connector webbing. Is the connector passed through the peak of the main canopy properly?

Test the action of the pilot chute spring by compressing it and then quickly releasing it. The notes in NAF blueprint 401220 state that the spring is to be completely compressed under a load of 25–30 pounds. Both ends of this spring are held securely in place by swaged fittings. Check all swaged fittings for security by exerting a straight pull of about 10 pounds; if the wire separates or is loose in the fittings, replace the assembly.

Look for stains in the cloth, they can be dangerous and bring about the complete deterioration of the unit. Do not test a stained area for deterioration by stretching the material between the hands or the fingers, as this method can be destructive to perfectly sound cloth. If you suspect acid, check the area with litmus paper moistened with distilled water. You may also GENTLY pick at the spot with a pencil eraser, while observing the material closely.

Acid will completely consume the fibres of the cloth causing them to flake away into a gray ash. Acid is one of the greatest enemies of the parachute.

Look for broken or loose stitching in the seams and hems, keeping in mind the fact that these stitches fasten one unit to the other and represent the parallel use of nuts, bolts, and rivets in machinery.

The pilot chute by virtue of its position in the pack takes a lot of punishment and yet must perform perfectly. Tears, holes, punctures, and chafed areas in the canopy of the pilot chute are caused by wear as the pilot chute is under constant tension and is located uppermost in the pack. The metal spring does not help this condition. Bent or broken springs and frames can cause failure of the unit. The seat type parachute adds to the effect of this situation by its own weight and that of the wearer. A Parachute Rigger should always keep one or two spare pilot chutes on hand for replacement purposes.

The Main Canopy

The main canopy often referred to as "the canopy," "the parachute," "the sail," or a number of other commonly used terms, is the main resistance area of the entire assembly. Canopies have been designed in many shapes and forms, but most of them were designed with these specifications in mind:

1. OPENING TIME: must be quick.
2. STRENGTH: shock of opening must not be too severe for the assembly or the wearer.
3. RATE OF DESCENT FACTOR: the assembly must provide a safe descent under all climatic conditions and at all landing elevations.

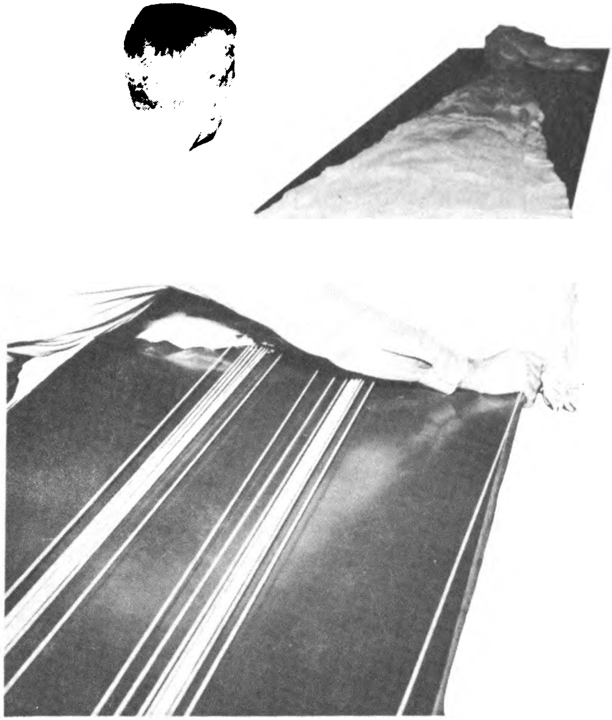


Figure 3–3.—Canopy inspection.

4. STABILITY: the oscillations must be kept to a minimum.
5. BULK: must be light in weight; the smaller and thinner the pack, the better.

Starting at the gore bearing the nameplate, the two suspension lines attached to the gores shall be taken, one in either hand, and spread out across the table. This will give you a commanding view from skirt to vent. Continue on around the canopy until all the gores have been checked. Figure 3–3 illustrates this operation.

Look for stained areas in the fabric that may lead to deterioration. Follow the procedure previously outlined for the pilot chute.

Check for broken or loosened stitching in the seams and hems. A pulled seam might indicate a weakened seam. Figure 3–4 illustrates a ruptured section of material.

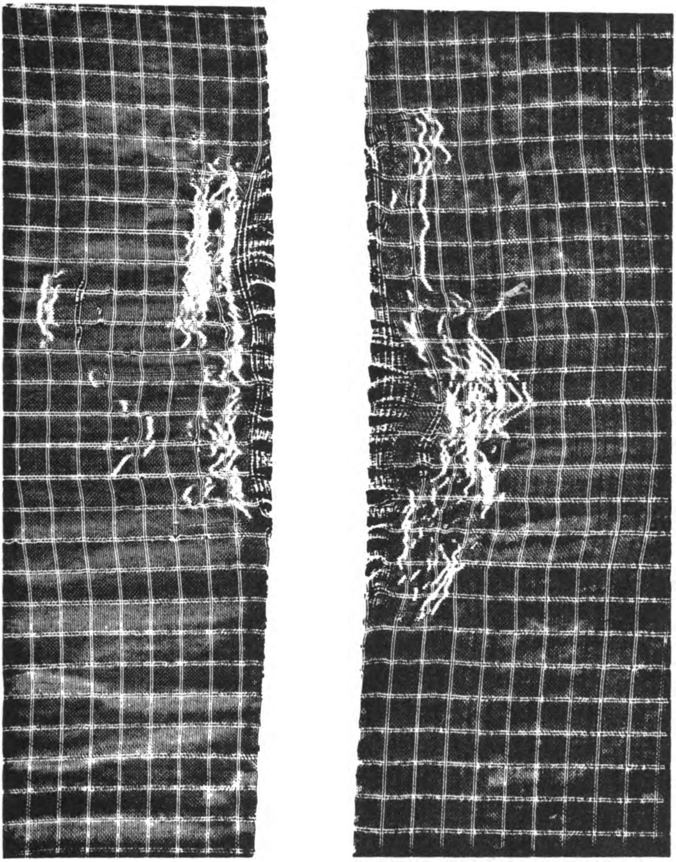


Figure 3–4.—Ruptured parachute cloth.

A few slight displacements of threads will not detract from the strength of the cloth, provided the threads are not too widely separated and are not broken.

Examine the points of zigzag stitching for security, and check the skirt reinforcements. Check the vent elastic for strength and resiliency by stretching the vent collar to its full opening. Examine the vent collar for security.

With the seat type parachute, sharp wrinkles and creases develop more readily in the fabric of the canopy than with

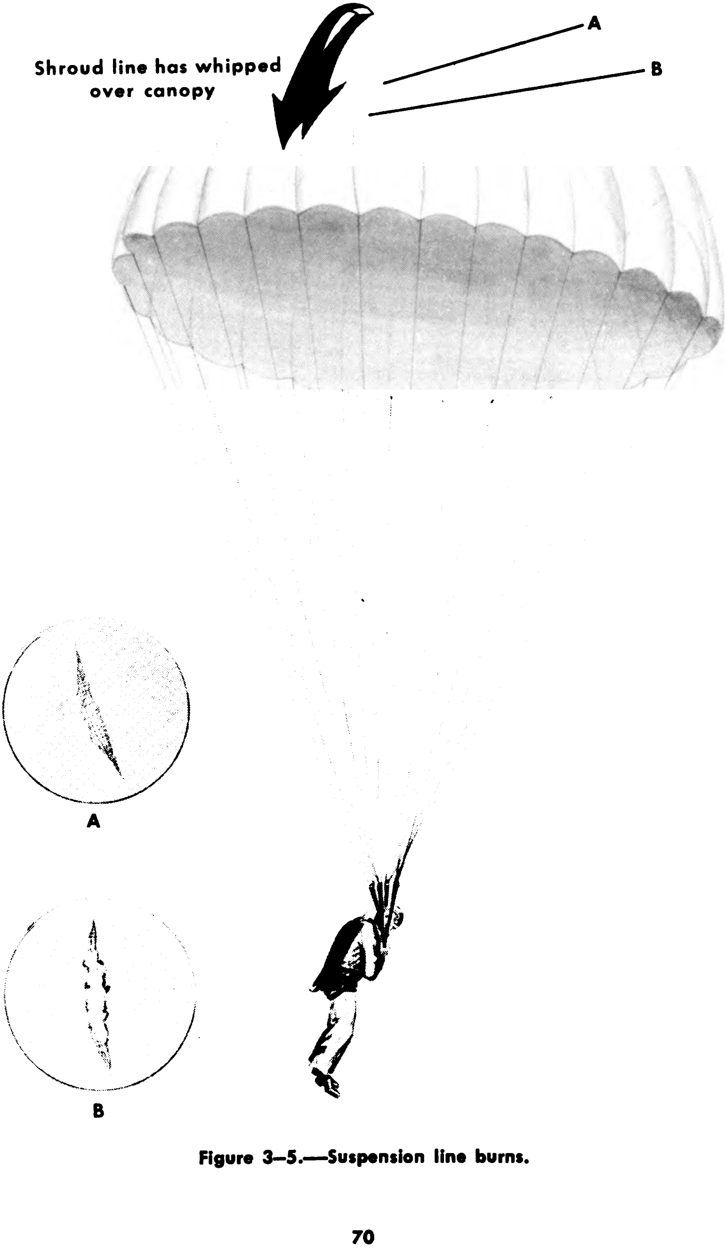


Figure 3–5.—Suspension line burns.

any other type. This is due to the position in which it is worn and the weight of the wearer.

Look for holes, tears, and chafed areas. Whenever a parachute has been jumped, inspect the canopy for suspension line burns. This type of damage actually sears the material causing brittleness and wide separations in the weave. Figure 3–5 illustrates suspension line burns and how they are caused.

Suspension Lines

Check the suspension line for evidence of fraying and any other sign of weakness. The inevitable stain problem is present here and the inspector should be very careful in his decisions. Suspension lines subjected to the injurious effects of perspiration turn a yellowish or dusty looking color. Check any area suspected of containing acids or alkalies with litmus paper and distilled water, using the method described in the latter part of this chapter. In any event, if you are not completely satisfied with the results of the test, take immediate steps to return the parachute for further tests and overhaul to the nearest major repair station.

Superficial snags in the outer covering of the cordage may be disregarded, but when severed inner cords protrude through the weave your only solution is replacement of the line. When snags cause an inner strand to protrude from the weave and form a loop that dangles from the suspension line, use a blunt instrument to push the inner cord back into the line.

Inspect the suspension lines for security to the links and to the canopy. Inspect the removable connector links for the security of the screws holding the link halves together.

Securing screws of the removable connector link (MS 22002–1) should be checked using a torque indicating screwdriver with a force not less than 20 inch-pounds and not more than 25 inch-pounds.

Later type connector links (Capewell 101714) do not require a specified torque setting but should be checked with an ordinary type screwdriver for security. Make certain that the sliding lock is properly seated all the way back and engaged in the grooves by observing the slide's position in relation to the outer smooth contour of the lock. The slide SHOULD NOT PROTRUDE. If the slide protrudes, loosen the binding screw, push the lock toward the center of the link, properly engage the slider in the grooves of the link stems, and retighten the screw.

Caution: Tightening the screw will not hold the side lock if the slide is not properly engaged.

Look for corrosion and rust under the suspension lines where they tie to the links. Rust and corrosion indicates that the cadmium plating has worn off the metal.

The suspension lines of the 28-foot flat type parachute are attached to the removable connector links in four groups with each group containing seven lines.

The lines of the conical 26-foot 22-gore canopy are attached to the removable connector links in four groups as follows: 1 through 5, 6 through 11, 12 through 17, and 18 through 22. Be certain that these lines run continuously, line for line, link for link, all around the periphery of the canopy without any entanglements or cross overs. The conical canopy is constructed differently from the older standard flat type and these differences must be taken into consideration when performing your inspection. Exercise extreme caution when checking the suspension line anchoring points around the skirt of the canopy. The same care must be applied to the anchoring points around the vent as these suspension lines do not run through the canopy from link to link as is the case with the older type canopy. There is no need for a vent collar inspection since the new design doesn't utilize this feature.

Harness

All webbing straps shall be checked for acid stains, defective stitching, and fraying. Several broken or loose stitches may be replaced provided the original length of stitching is followed with the appropriate thread or cord and the sewing is done with the "right and left" method or with a machine lockstitch. Do not attempt to make other repairs.

Send the harness to a major repair station via the Supply Department for disposition.

Look for chafing or shearing at the load points. Recheck the proper attachment of the lift webs to the removable connector links. This is an extremely vital attachment and too much emphasis cannot be placed on the importance of this connection.

Have all the latest modifications been incorporated in the assembly? Are you complying with the current directives? Do you check regularly with your publications officer and make certain that you haven't missed anything? You should know everything that is contained in the *Parachute Manual*, NavAer 13–5–501, as this is your basic manual that carries with it the authority needed to guide you in your work.

Check the harness straps for twists. Sometimes these twists are permanently sewed into the assembly erroneously by the manufacturer or major repair activity. The harness is fitted with numerous pieces of hardware. Look for rust and corrosion around these points. Whenever springs are incorporated in the hardware be sure to check the spring tension by compressing and releasing the "tongue" against which the spring bears. Observe this action. Is it positive and springy, or does it lack the life that was originally built into it? Do not permit rust to remain in contact with nylon or any other fabric. The best policy to follow is cleanliness at any price. Rusty hardware should be replaced by a major repair station. Make sure that the hardware on each harness is of the proper type. Friction hardware should work freely and contain no burrs.

The lift web assemblies of the quick attachable chest type parachutes are checked much the same as the procedure outlined for the lift webs of the "fixed type" harness. Make absolutely certain that every quick attachable chest type lift web assembly is fitted with a cross connector strap or yoke. The cross connector strap or yoke joins the snaps into one unit. Figure 3–6 illustrates the importance of a cross connector strap.

The majority of quick attachable harnesses is stowed in aircraft and should not be overlooked at the time the para-

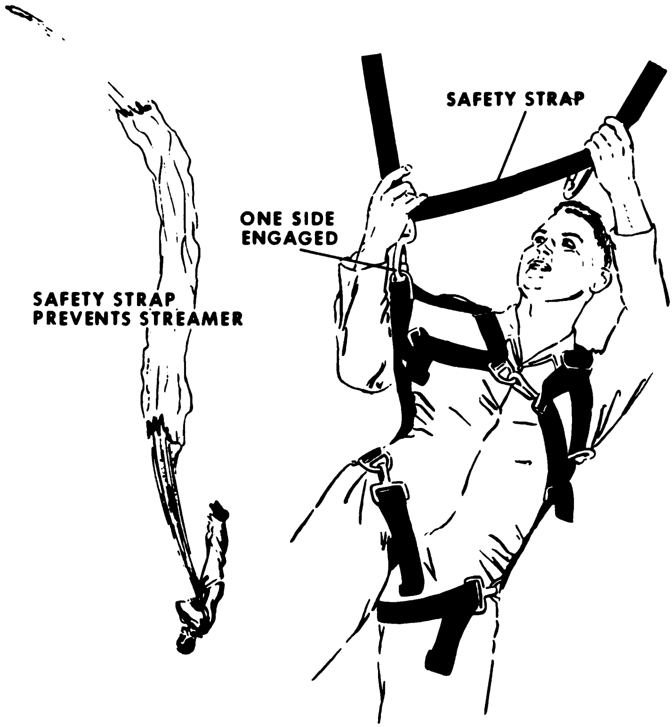


Figure 3–6.—Importance of cross connector strap.

chute is inspected and packed. Schedule and make regular harness inspections in the aircraft. The harness must be inspected by a qualified Parachute Rigger. Personnel having harnesses in their custody should be required to turn them in periodically for inspection.

Pack or Container

The parachute pack or container is the most abused item of all the assemblies and therefore demands much of your attention. A careful inspection of the pack or container before going into the packing operation will save a lot of work. No sewings or tackings can be made through the pack or container after the parachute has been packed. "Inspect, then pack." Let that be your slogan.

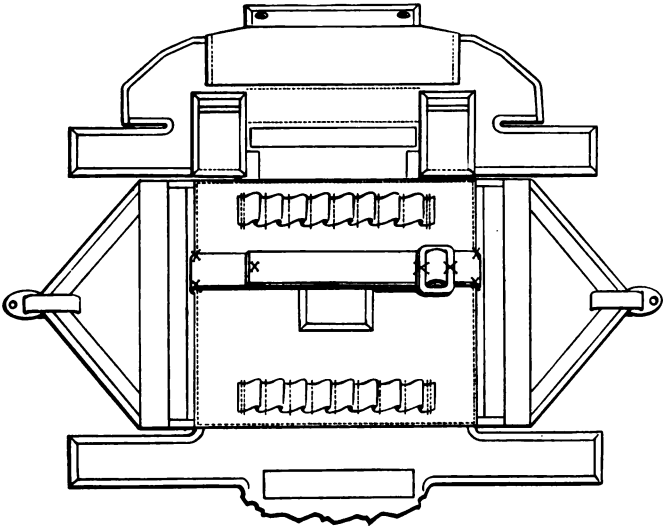


Figure 3–7.—Proper method of securing pack to harness.

Examine the pack or container for acid stains, holes, and tears. An innocent looking dirt mark can contain a harmful ingredient that will destroy the fabric. Keep your eyes open for oil marks and smudges that can be picked up from transporting vehicles. Dirty parachute packs or containers and harnesses are an indication of carelessness. Small holes can be darned with the appropriate thread while larger ones require patching. Patching will be treated in chapter 9.

Check the pack or container for security to the harness, and for the security of one subassembly or unit to the other. Make certain that the pararaft retaining webbings pass through the pack as illustrated in figure 3–7.

You don't want the pack flying off of the harness when the wearer falls through the slipstream or is ejected through space. The pack is the parachute assembly in a ready service condition. Let's make certain it stays that way: READY. Check the raft case for security. Are all the tackings in their appointed places and are they securely tied? Has the approved cord or thread been used?

Bent pack frames can be straightened safely only after being removed from the pack or container. Pack stiffeners seldom give any trouble. Occasionally one may protrude from its pocket, requiring a little hand or machine stitching to remedy. Examine the pack or container hardware for condition and security. The locking cones and grommets must be perfectly smooth without the slightest trace of a burr which could cause the failure of this unit. A burr is a roughness, usually found on the edge of the cone or grommet. There can be no roughness in the releasing device of a parachute whether it be the old standard grommet and cone or the latest chain lock type.

Do not tolerate loose fitting or "pulled" pack grommets. A grommet that has pulled loose is detrimental to the operation of the parachute. A "setting method" has been developed whereby the heat generated from punching the grommet hole in the nylon material causes the edge of the hole to sear which helps to prevent the grommet from tearing loose. Pack or container grommets are a special type and cannot be set with ordinary dies. When a grommet associated with the releasing device of the parachute pulls out of its setting, the pack should be renewed.

Check the pack opening bands for spring action, damage, twists, and fouling.

Make sure that everything is sewed in its proper position and is anchored securely. The suspension line loops or hesitator loops are given a great amount of abuse every time a group of lines is drawn through them in packing the parachute. The pilot chute protector flaps, end flaps, corner flaps, and lift web protector flaps are other items on the torture list to be given special attention.

These parts are subjected to strains during packing and require occasional repairs. Check the technical publications and you'll find that the parachute pack has undergone more modifications and improvements than any other item.

Ripcords, Housings, and Pockets

Examine the ripcord for bent or burred locking pins, keeping in mind that these pins must be smooth. Check

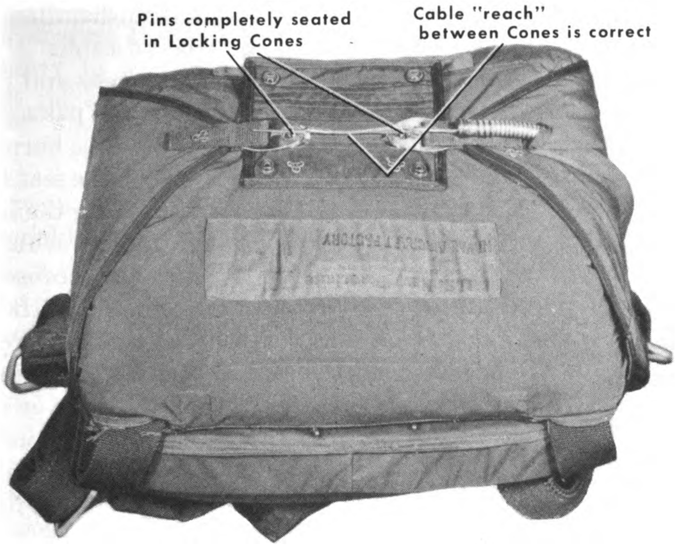

Pins completely seated in Locking Cones
Cable "reach" between Cones is correct

Figure 3–8.—Proper pin spacing.

the swaged connections for looseness by exerting a straight pull on the pins with the fingers. Examine the cable for broken strands, kinks, and rust. Rust can sometimes be removed by wiping the cable with a light oil. Rub off all visible traces of the oil after applying it.

Check the ripcord pin spacing with the cone spacing on the corresponding pack or container. The pins should be completely through the cones without bending the cable, as illustrated in figure 3–8.

Inspect the cable for excessive wear at the grip connection. Pull the cable out of the grip as far as it will go to check the "stop" on the extensible type ripcords.

Check the ripcord housing for rust, kinks, breaks, and the condition of the ferrules at each end. The extensible type housing used with the seat type parachute should extend to the specified limit, and when released should return to its normal state unimpaired and without aid. This condition cannot be checked with the housing already in a tacked position and there is no need to cut it free to make this inspection as this is only a preinstallation check. The extensible type housing tends to come apart at the joints if mishandled and offers a sharp edge that may foul the ripcord cable.

Check the security of the housing to the harness and pack or container. Replace all loose tackings. Is the passage of the housing correct? Is the housing too low on the harness? If the housing and pocket are located too low on the seat type harness, a stout man will have difficulty in reaching the hand pull with his right hand, especially when the parachute is rigged with the pararaft kit. This is important because the seat type parachute is usually rigged with the pararaft kit.

The ripcord grip pocket must be secure and in the proper location on the harness. In the case of the chest type parachute the ripcord grip pocket is located on the pack or container. The elastic should hold the grip firmly but not to the extent of rendering the extraction difficult. Remember that 22 POUNDS is the maximum allowable pull required to release the parachute when testing.

Seat Cushion and Back Pad

Inspect for security and proper tacking. These items are installed to provide comfort and a perspiration barrier. Watch those back pad keepers; see that they hold the pads where they belong. Keep them clean. Dirt destroys confidence in spite of the fact that the parachute is packed and rigged perfectly. Oftentimes careless personnel in a squadron use the seat cushions attached to the parachutes as a step in getting in and out of the aircraft. This is a bad practice and should be discouraged.

Seat Pan

The seat pan is a seat cushion with an inner aluminum frame shaped like an old iron tractor seat. This frame is topped with sponge rubber and covered with the same material as the seat cushion. The same inspection pattern holds true of this item as for the seat cushion except when it is rigged with the oxygen bail-out cylinder. Check the zippered cover which encloses the cylinder for smooth opening action. Look for worn and chafed areas where the cylinder bears against the fabric cover. A reinforcement may be necessary to prevent the cylinder from wearing through. Check the cylinder pressure.

STAINS

A stain not only ruins the appearance of an object but it also could cause physical damage. We are primarily interested in the damaging effects of a stain. Certain oils, dirt, food, and other products contain acids in varying percentages.

A strong acid is certain death to fabric and rapidly brings about the complete deterioration of the affected area. The time necessary to bring about its destruction is determined by the strength of the solution. It is your job during the inspection of the parachute to locate stained areas and to test these areas for acid or alkaline content. The removal of the stains and other cleaning problems will be described in chapter 9.

Litmus paper provides a reliable and simple means for detecting the presence of acids or alkalies. Blue and red litmus paper is available through standard stock issue. To test for acid content dampen the affected area with distilled water while touching it with a strip of blue litmus paper. If the blue color turns to red, acid is present. To test for an alkali dampen the affected area with distilled water while touching it with a strip of red litmus paper. If the red color turns blue, an alkali has been detected. Immediate steps must be taken to neutralize the caustic and damaging effects of these elements.

Canopies badly stained with grease, oil, or other injurious substances should be returned to a major repair station for repair after steps have been taken to neutralize the damage.

TENSILE STRENGTH

Tensile strength is the greatest longitudinal stress a substance can bear without tearing. Throughout the entire life of a parachute this is the most important characteristic to be safeguarded. All of the materials that are used in the con-

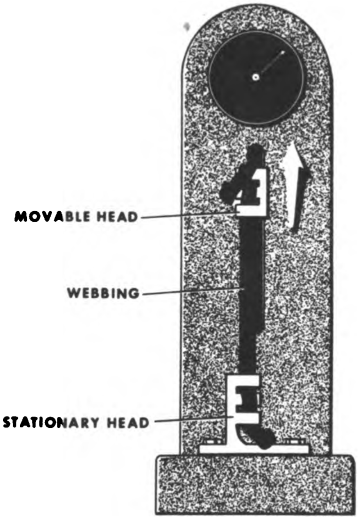


Figure 3–9.—Testing for tensile strength.

struction of a parachute have been tested and retested in the laboratory to ascertain that their tensile strengths are in accordance with the highest standards of the industry. The nylon cloth, webbings, tapes, and threads are all top quality.

To determine the tensile strength of a strip of cloth or a length of webbing, it is subjected to a break test on a machine. The figure indicated on the measuring instrument is expressed in pounds of breaking strength. For example, the tensile strength of a certain type of soft nylon webbing is 6,000 pounds minimum. The minimum figure signifies that the 6,000-pound strength will not only be reached but will be exceeded by this material. All subsequent samples of this particular soft nylon weave webbing must test at the minimum figure or above in order to be accepted for parachute use. Figure 3–9 illustrates the testing instrument in action.

Every new lot of material received by the parachute manufacturer is tested not only for tensile strength but for other properties as well to make certain that the finished product will meet the rigid specifications of the acceptance tests.

If for any reason you question the strength of a suspension line or any other part of the parachute, it shall be turned in to a major repair station for test. You cannot look at a piece of material and be absolutely certain it will meet the tensile strength specifications. It must be tested on a machine.

TRANSFER

Parachutes not requiring repair CANNOT be transferred from the unit to which they have been assigned without authority from your aviation supply officer. All transportation involving shipment of parachutes to major repair stations shall be by government conveyance.

DISPOSITION OF REPAIRS

The following list is offered as a guide to aid in the dispositioning process. This list shows what defects constitute a major repair which may be carried out only by an authorized repair station equipped for this work. Also, it lists minor repairs which may be carried out by the Parachute Rigger. Chapter 9 will deal with many of the procedures involved in the accomplishment of minor repairs.

Pilot Chute and Main Canopy

Inspect for	*Disposition*
1. Security of pilot chute to main canopy.	Minor repair; retie or replace webbing.
2. Bent or broken spring.	Minor repair; straighten or replace pilot chute.
3. Loose swaged fittings.	Minor repair; replace pilot chute.
4. Modifications in accordance with technical publications.	Generally involves a minor repair, but occasionally involves a major repair.
5. Damaged suspension lines.	Major repair; replacement of line or group of lines.
6. Suspension lines secured out of rotation on the removable links.	Minor repair; slip lines off removable link and replace in proper sequence.

Pilot Chute and Main Canopy (Con.)

Inspect for (Con.)	*Disposition* (Con.)
7. Stains.	Minor or major repair, depending on the origin and size of area or areas stained. For minor repair, test for a caustic substance in the affected area and in the adjoining areas. After a negative test, wash and dry, then retest. Advanced small caustic stained areas may be cut out, treated as a tear and patched. Areas indicating a caustic element but not suffering any apparent damage may be neutralized, washed, and dried. Retest. A "canopy change" is classified as a minor repair so long as no sewing is involved in the operation. Large or numerous small caustic stained areas require a major repair classification.
8. Tears in the cloth.	Minor repair with limitations.—Tears 8 inches or under not crossing radial seams, diagonal seams, skirt, or vent hems. Only two single or one double patch per section, and when it becomes necessary to exceed this, the repair is classified as major. Major repair.—Tears or holes greater than 8 inches. Any size tear across seams or the vent and skirt hems.
9. Security of tackings. (Pilot chute vane type.)	Minor repair; retack.
10. Loose or severed stitching.	Minor repair; brush lose stitching back into cloth. Short lengths of damaged stitching may be resewed.
11. Damaged vent ring.	Minor repair; replace.

Harness and Pack

Inspect for	*Disposition*
1. Security of lift webs to links.	Major repair; if lift web attachment sewing is involved. Minor repair; tighten removable connector link screws to proper torque.
2. Damaged webbing: badly chafed, separated, or cut.	Minor repairs; harness replacement involving no sewing; salvage hardware.
3. Modifications in accordance with technical publications.	Generally involves a minor repair, but occasionally involves a major repair.
4. Security of all harness tackings; ripcord housing, grip pocket, lift webs to pack, pararaft kit container, seat cushion and back pads, etc.	Minor repair; retack where necessary.
5. Loose or severed harness stitching.	Major repair; if more than several stitches replace harness. (Replacing harness is a minor repair when lift web sewing is not involved.)
6. Stained and dirty harness.	Minor repair; test for caustics, if present, remove harness, neutralize, wash, dry, and retest. If any doubt of the tensile strength exists, return harness to major repair stations for test.
7. Improper location and operation of hardware. Permanent twists in chest and back straps.	Major repair; return harness to major repair station for overhaul.
8. Security of pack to harness.	Minor repair; machine sew keepers, retack. All pack changes are classified as a minor repair.
9. Damaged ripcord, housing, grip pocket, back pads, and seat cushions.	Minor repair. Replace and salvage damaged parts.

Figure 3–10 illustrates a 28-foot canopy chart and inspection report form used by activities servicing parachutes.

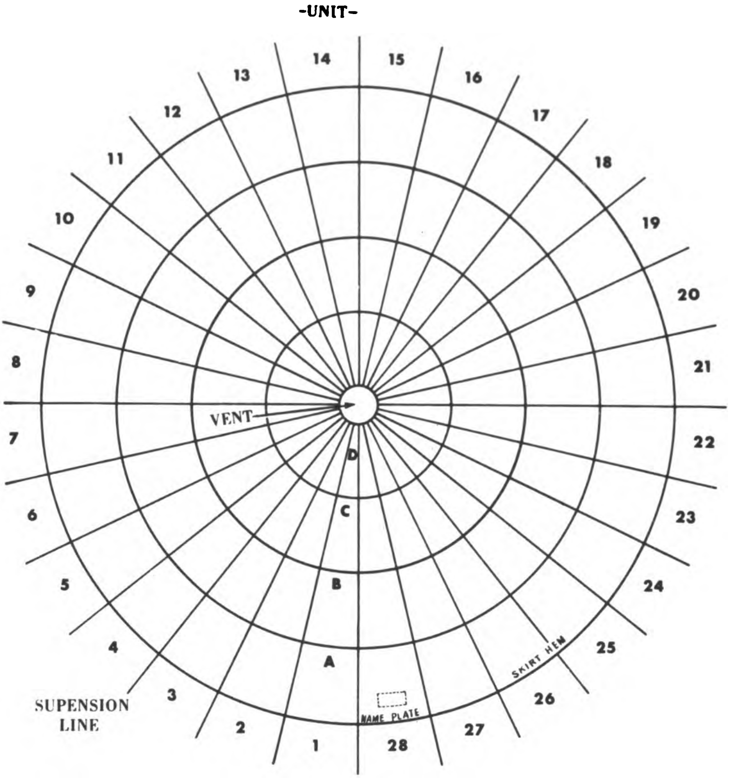
Any time a parachute is forwarded to a major repair station for examination or repair the completed canopy chart

INSPECTION REPORT Date____________

Parachute No.____________ Inspector____________

PART	O.K.	REATTACH	REPAIR	REPLACE	REMARKS	CHANGES (Authorized by)
A. HARNESS:						
Hand Grip Pocket						
Ripcord Housing						
Releasing Device						
Webbing and Attachment						
Metal Fittings						
Back Cushion						
Modifications						
B. PACK:						
Cushion						
Suspension Line Loops						
Flaps and Tabs						
Stiffeners						
Pockets						
Grommets						
Cones						
Hooks and Eyes						
Elastics						
Frame						
Modifications						

C. SUSPENSION LINES:						
Zigzag Stitching						
Suspension Lines						
Links to Skirt						
D. CANOPY:						
Fabric						
Skirt						
Radial Seams						
Zigzag Stitching						
Diagonal Seams						
Vent Collar						
Vent Ring						
E. PILOT CHUTE:						
Pilot Chute Tie						
Cord						
Fabric						
Rib Pockets						
Wire Frame						
Suspension Lines						



SERIAL NO: ______________ DATE: __________________________

TYPE ____________________ INSPECTOR __________________

RED-RUPTURES BLUE-CORDAGE BURNS GREEN-SEAM SEPARATION

REMARKS. ____

Figure 3–10.—Canopy chart.

(fig. 3–10), an inspection report form, and the Parachute History Card (NavAer–2771), must accompany the parachute in its shipment. This information will expedite the return of parachutes to active service by permitting immediate attention to those parachutes most readily repairable.

The parachute inspection form recommended by the *Parachute Manual*, NavAer 13–5–501, may be prepared locally for use of activities servicing parachutes. Use of the inspection form and canopy chart discourages the prohibited practice of personnel making marks directly on the parachute when a defective area is noted. A copy of the inspection form is shown on pages 84 and 85.

QUIZ

1. What is the largest canopy tear that can be repaired within the squadron?
   a. 6 inch
   b. 8 inch
   c. 12 inch
   d. 1 panel
2. On which gore does the nameplate appear?
   a. 1
   b. 14
   c. 27
   d. 28
3. Which of the following repairs is considered a major repair?
   a. Replacement of a suspension line
   b. Replacement of the canopy
   c. Replacement of the vent ring
   d. Replacement of the container
4. Which officer can authorize the transfer of parachutes from one unit to another?
   a. Operations Officer
   b. Material Officer
   c. Supply Officer
   d. Commanding Officer
5. The bail-out cylinder is installed on the parachute in
   a. a special bag
   b. the seat pan
   c. the seat cushion
   d. the back cushion
6. How can you detect the presence of acid on parachute fabrics?
   a. By sight
   b. By smelling the stained area
   c. By the use of litmus paper
   d. By drop testing the parachute

7. Which of the following repairs is considered a major repair?
   a. Changing the canopy
   b. Changing harness hardware
   c. Changing the container
   d. Changing the vent-ring
8. In testing, the maximum ripcord pull allowed to release the parachute is
   a. 18 pounds
   b. 22 pounds
   c. 25 pounds
   d. 30 pounds
9. What is the main safety feature of the NC3–R lift web assembly?
   a. Capewell connector links
   b. Cross connector strap
   c. "W" sewed loops
   d. Butterfly tacking
10. The two screws of the removable connector link are torqued to a maximum of
    a. 20 inch-pounds
    b. 22 inch-pounds
    c. 25 inch-pounds
    d. 30 inch-pounds
11. How many rows of stitches pass through the entire length of the radial seam?
    a. 2
    b. 3
    c. 4
    d. 6
12. In order to adequately inspect a parachute the Rigger should be familiar with the
    a. related publications
    b. Squadron Regulations
    c. Station Regulations
    d. General Orders
13. Which agent is most destructive to the parachute fabric?
    a. Acid
    b. Hydraulic fluid
    c. Perspiration
    d. Solvent
14. Which factor is most important in the design of a service parachute?
    a. Bulk
    b. Strength
    c. Stability
    d. Rate of descent

15. The pilot chute spring must completely compress under a maximum load of
  a. 22 pounds
  b. 30 pounds
  c. 40 pounds
  d. 45 pounds

16. The pilot chute swaged fittings are tested by a straight pull of about
  a. 10 pounds
  b. 18 pounds
  c. 22 pounds
  d. 30 pounds

17. How many major parts make up the complete parachute?
  a. 2
  b. 3
  c. 4
  d. 5

18. Which is a minor component of the complete parachute?
  a. Vent collar
  b. Canopy
  c. Suspension line
  d. Harness

19. Which publication lists the major repair stations for parachutes?
  a. NavAer 13–5–501
  b. NavAer 13–5–505
  c. NavAer 00–500
  d. NavAer DD 535

20. A lighted inspection table is used to check
  a. canopy stains
  b. stitches in canopy seams
  c. suspension line continuity
  d. vent collar security

21. What is the service life of a Navy parachute?
  a. 4 years
  b. 5 years
  c. 7 years
  d. Has not been determined

22. Parachutes unsuitable for service are
  a. scrapped and burned
  b. auctioned off locally
  c. converted to cargo chutes locally
  d. forwarded to NAF

23. Canned parachutes in supply storage are inspected, dried, and repacked every
   a. quarter
   b. 6 months
   c. 12 months
   d. 36 months

24. Parachutes and parachute spare parts are listed in the ASO Catalog under
   a. Class 27
   b. Class 41
   c. Class 83
   d. Class 265

25. Parachutes are table inspected at least once every
   a. 10 days
   b. 30 days
   c. 60 days
   d. 90 days

26. Which check is not pulled at the 10-day inspection interval?
   a. Continuity of suspension lines
   b. The safety thread on locking pins
   c. Security of tackings
   d. Harness for wear or stains

27. The minimum strength of a canopy suspension line is
   a. 200 pounds
   b. 300 pounds
   c. 450 pounds
   d. 550 pounds

28. When in doubt about the strength of a parachute part, you would
   a. drop test the parachute
   b. turn it in for test and overhaul
   c. inspect and place it in storage
   d. inspect and place it in service

CHAPTER 4

PACKING AND RIGGING

Packing is more than a matter of inserting a canopy into its pack. Parachute packing is a system. It is a combination of inspecting, packing, and rigging. However, most of the inspection phases of the operation can be carried out independently. Thus, inspection was treated separately in the previous chapter. The perfect working of the parachute depends on the methods used in the packing and rigging processes. Packing is essentially the same for all parachutes, although the external rigging will differ considerably. If a thorough and reliable packing procedure is understood, a Rigger will be able to apply that knowledge to any type of parachute and will be able to pack a parachute in a short period of time.

The beginner may take as long as 45 minutes to pack a parachute. A large part of that time will be spent on the stowage of suspension lines. After a few weeks practice, this time will shorten to an average of 20 minutes or less until peak performance is reached. Due to the uniform system taught to Navy Riggers, any two men can soon work in harmony and form a good packing team. Remember, speed is secondary to accuracy. Recognize your best packing speed and settle down to a good reliable pace that guarantees perfection.

PACKING TOOLS

Tool Kit

Examination of the Parachute Rigger's packing tool kit (fig. 4–1) reveals a simple array of tools. The individual tools, while unimpressive in appearance, are quite specialized in application. The individual tools cannot be drawn from stock; they are issued only in the complete kit.

In a previous chapter you read of the varied nature of the Parachute Rigger's work. During earlier days when parachute rigging was extracurricular, Riggers made their own tools, usually while in school as students learning to pack and rig parachutes. In the early 40's the first manufactured tool kits were purchased by the Navy. These tool kits were issued by the Parachute Rigger School to its students upon graduation. Later these kits were made available through various Navy supply points. The kit, as issued, is intended for packing purposes only.

Tools contained in the standard kit are shown in figures 4–2 through 4–7.

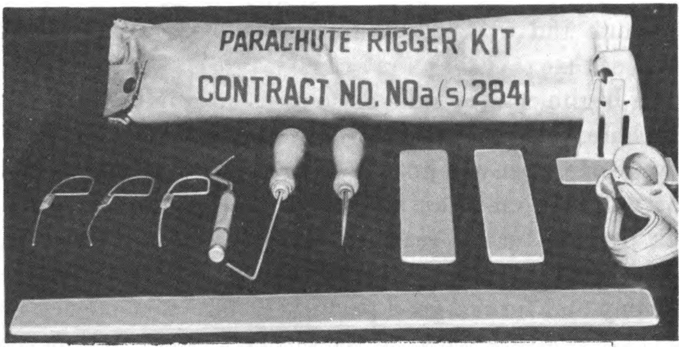


Figure 4–1.—Parachute Rigger's packing tool kit.

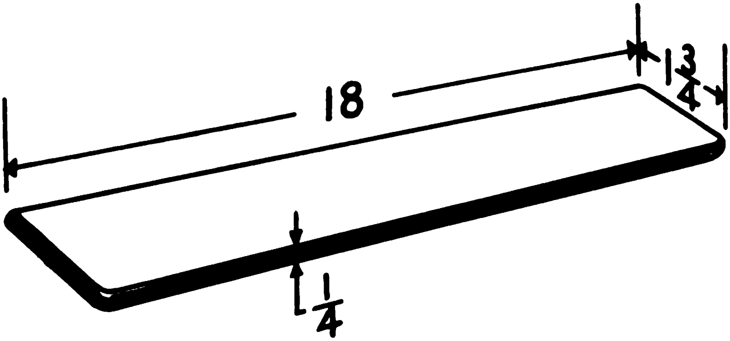


Figure 4–2.—Long bar.

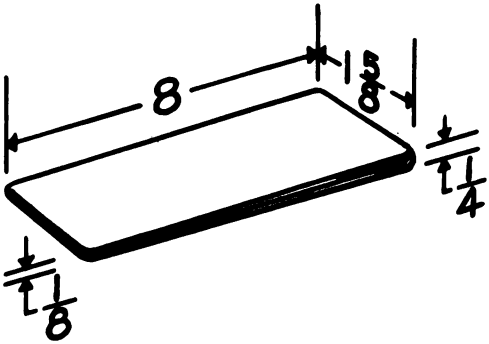


Figure 4–3.—Fid.

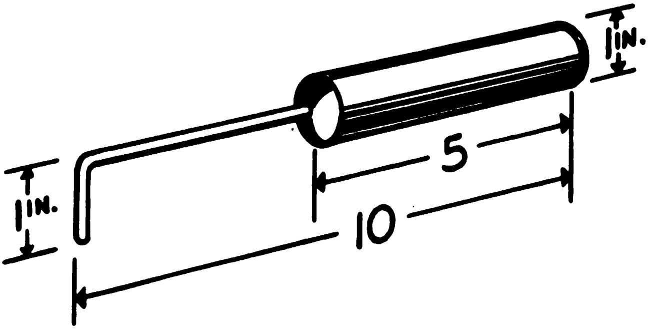


Figure 4–4.—Suspension line hook.

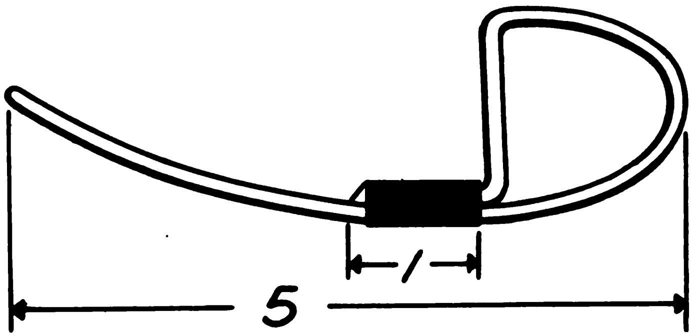


Figure 4–5.—Temporary locking pin.

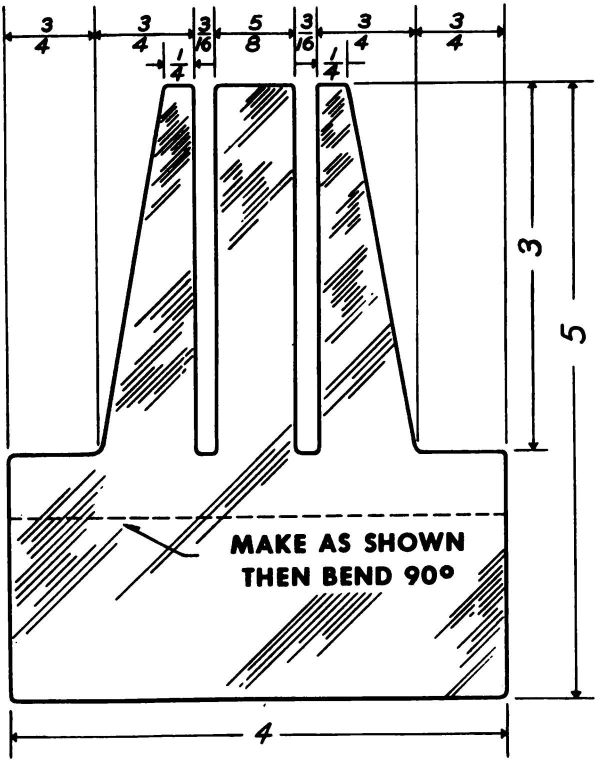


Figure 4–6.—Suspension line holder.

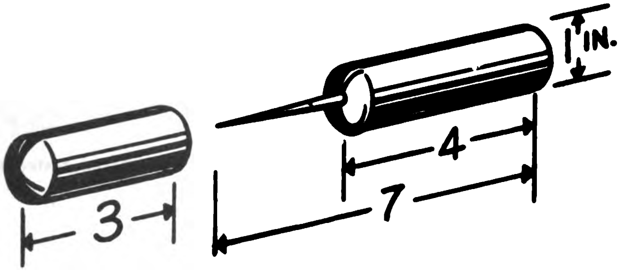


Figure 4–7.—Awl.

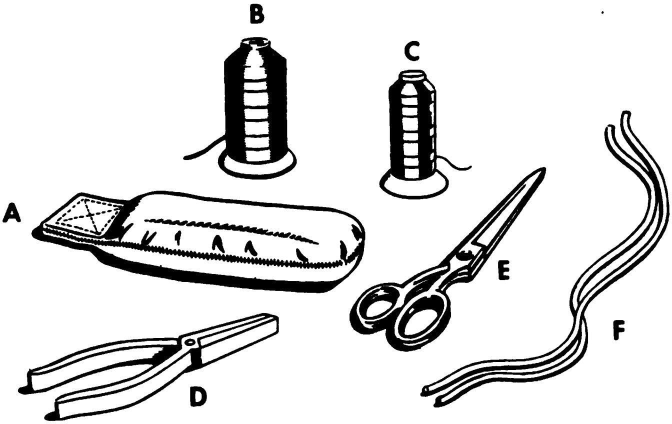


Figure 4–8.—Shot bag, cord and thread, pliers, scissors, and closing cords.

The tools contained in the standard tool kit are sufficient for packing the standard chest, seat, and back type parachutes. Additional items, consisting of shot bag (A), cord (B) and thread (C), pliers (D), scissors (E), and closing cords (F), are required for packing and rigging. (See fig. 4–8.)

The special tools required to assist in closing the pack of the chain closed fastener type parachute (NB4–R and O) are shown in figure 4–9. Note the slider, which is the principal tool used in closing the pack. Other special tools that are helpful and which can be made locally are shown in figure 4–10.

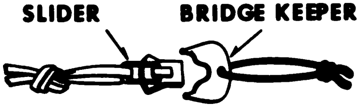


Figure 4–9.—Special tools required for closing the chain closed fastener pack, carried in a pocket attached to the pack.

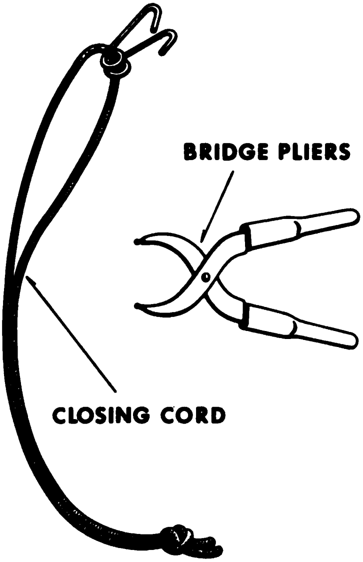


Figure 4–10.—Other special tools.

Scratched or burred tools constitute a threat to the fabric parts of the parachute. Maintain your packing tools in a perfectly clean and smooth condition. The long bar and fid are made of aluminum alloy, and consequently damage easily. Do not use these tools for any purpose other than that for which they are intended. The suspension line hook is manufactured from a length of steel wire fastened to a handle and bent 90° one inch from the end. Figure 4–11 illustrates a stronger and more efficient hook which you can make in the shop.

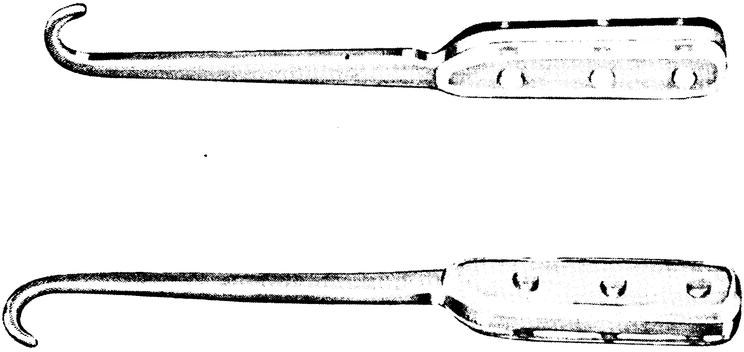


Figure 4–11.—Suspension line hook, locally made.

Hand Sewing Needles

Sail needles are too large and bulky for use as a regular tailor's needle, but are necessary when working with heavy material. Most tackings on the parachute are accomplished with a sail needle and sewing palm. Some prefer a pair of smooth jawed pliers to the palm for pushing the needle through tough material. The general rule to follow in selecting the proper needle size corresponding to the cord size is: THE CORD SHOULD PASS FREELY THROUGH THE EYE OF THE NEEDLE. Difficulty is encountered in passing a needle through a piece of cloth when the needle is threaded with a cord too heavy for the eye. (See fig. 4–12.)

The eye of the needle is intended to offer just enough resistance to the thread or cord so that the needle will hold its place and not slide out of position. An improper selection will interfere with speed and efficiency and will increase the possibility of damaging the material. Numbers 14 and 16 are the most popular sail needles used in parachute work.

There are three common types of needles used for general hand sewing:

1. Sharps: standard length, small round eye.
2. Betweens: short length, small round eye.

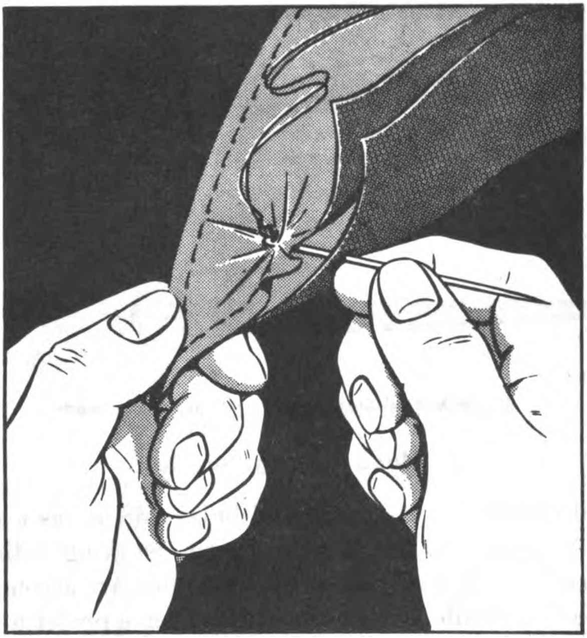


Figure 4–12.—Needle fails to make large enough hole for the cord.

3. Crewel: standard length, narrow eye; large size for yarn work.

The choice of a type of needle depends upon the kind of sewing to be done. Needles are issued by number. The ordinary hand sewing needle ranges in size from 1 to 12. The higher the number, the finer the needle.

Good grade needles are issued in a specially treated black paper package. When needles are not in use, they should be replaced in this specially treated package as it prevents rusting. (See fig. 4–13.)

The sail needle is the toughest hand sewing needle you can find. It will take a lot of rough use without breaking at the eye as many of the round needles do. The distinctive feature of the sail needle is its broad, three-edged shape in relation to its size. This sometimes prevents its use in hard, closely woven cloth. Loosely woven fabrics are most adapta-

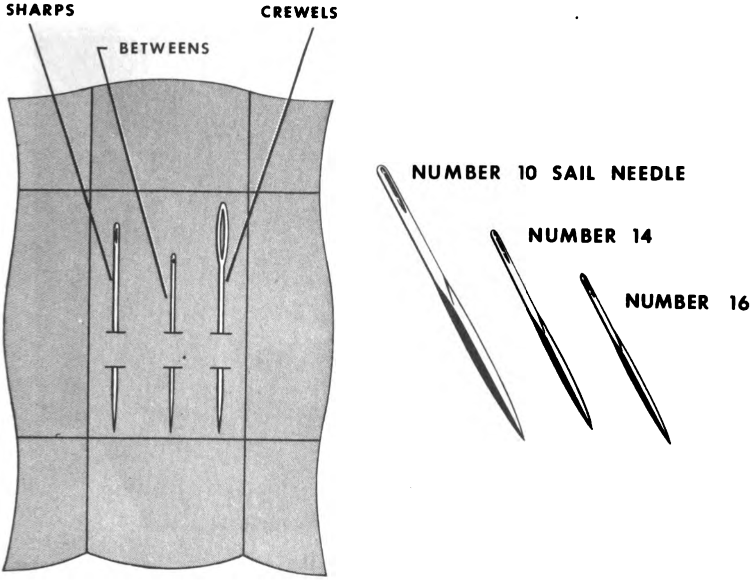


Figure 4–13.—Needles used for general hand sewing.

ble to sail needlework. There are a few carpet type needles adaptable to tacking threads and cords, but they lack the necessary strength in the eye. To make a tacking requires a lot of push and sometimes pull. No one's finger is tough enough to do the job. That's when a palm or a pair of smooth jawed pliers come in handy. When applying the force necessary to drive the needle through, be careful not to apply a side thrust as this may break the needle. Always apply a straight, steady push or pull, taking care not to mar or scratch the needle. The careful use of smooth jawed pliers is emphasized, as they will not scratch as easily as a pair of rough jawed gas pliers. Keep needles smooth and the points sharp by frequent use of a sharpening stone.

SUSPENSION LINE ENTANGLEMENTS

Entanglements are caused by the canopy or harness passing in between the suspension lines. In chapter 2 we studied the method of attaching the suspension lines to the links and

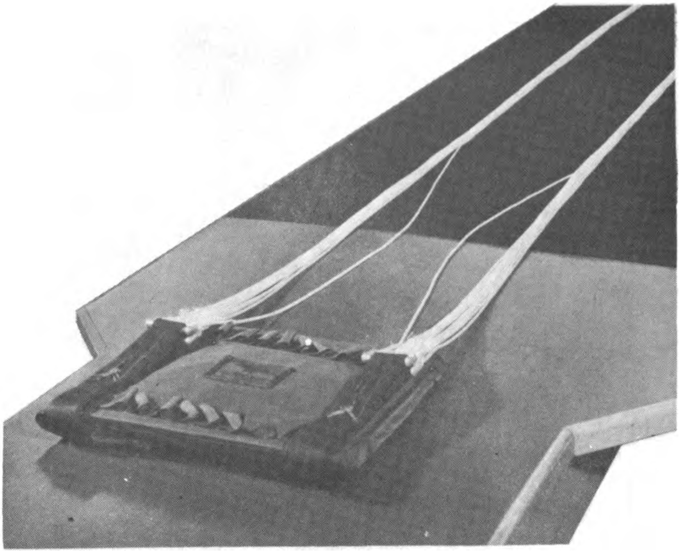


Figure 4–14.—Entanglement resulting from the canopy or harness passing directly between the dividing groups of lines.

in turn how the links are attached to the lift webs of the harness (lift web assembly of a chest type parachute).

A canopy or harness, with pack attached, may pass between any number of the suspension lines and from any angle. The simplest entanglement occurs when the canopy of harness passes directly forward or backward between the two major dividing groups of lines. The dividing groups (suspension lines) on a 28-foot parachute (wearer in harness, canopy nameplate forward) are numbered from 1 to 14; all the lines of this group are connected to the links of the two right lift webs. Suspension lines numbered from 15 to 28 are connected to the links of the two left lift webs. Figure 4–14 illustrates this simplest type of entanglement.

When the canopy and harness pass between the lines while the lines are twisted, or pass through from a sharp angle, a different type of entanglement results. This type of entanglement is not as orderly as the type first described. The second type can result from any number of entangling conditions; but regardless of how badly the suspension lines

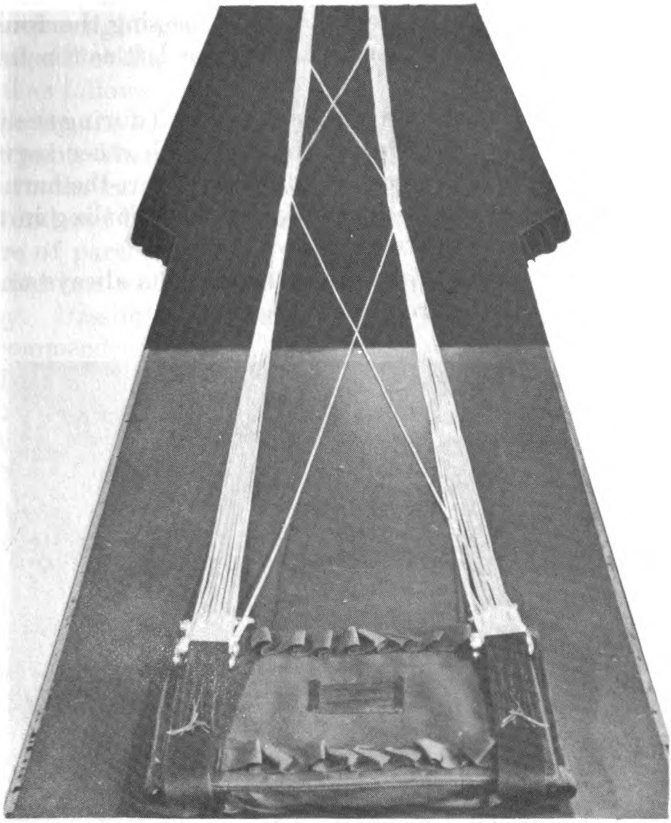


Figure 4–15.—Right and left group of suspension lines entangled. One suspension line from the left group is entangled in the right group, and one suspension line from the right group is entangled in the left group.

become entangled, this second type of entanglement is easily recognized and just as easily removed. Figure 4–15 illustrates the simplest combination of this type of entanglement.

Removing Entanglements

The first consideration in the methods employed to disentangle a fouled parachute is to do it without damage to the suspension lines and canopy. The RIGHT AND LEFT METHOD is the best method to use in removing fouls in a parachute. This system of removal gets its name from the fact that entanglements are removed by passing the fouled lines around the pack either to the right or left as the fouls indicate.

The chest type parachute harness is removed during the untangling process. Such is not the case with other service parachutes where it is necessary to closely secure the harness to the pack in order to keep the harness from fouling in the lines as they are passed around the pack.

Before proceeding to remove entanglements always untie any knotted portions from the suspension lines.

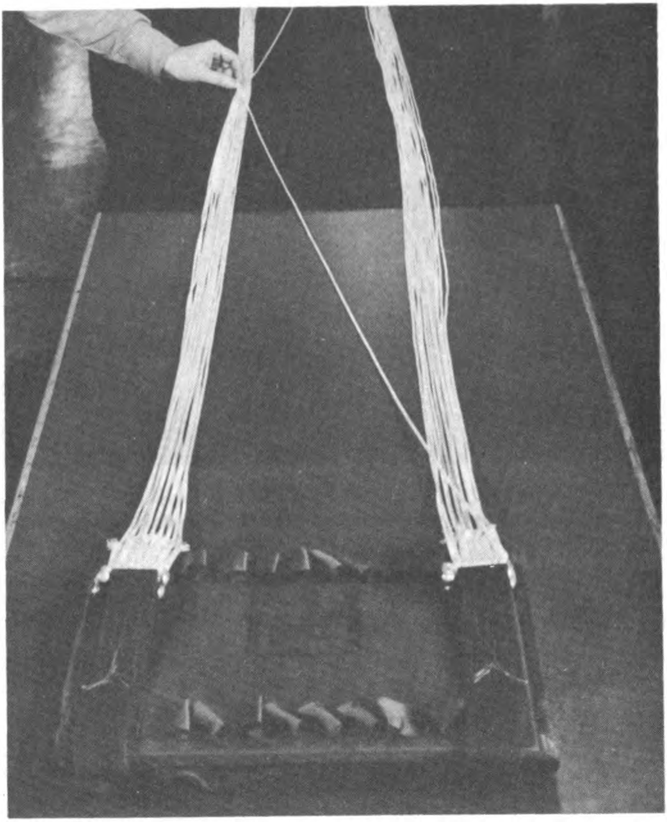


Figure 4–16.—Grasp fouled line where it crosses over the left group and prepare to return it to its own group.

THE RIGHT METHOD.—When a single suspension line from the two right groups of lines is entangled in the two left groups (looking toward the canopy), proceed to remove the foul as follows:

Grasp the suspension line belonging on the right side at the point where it crosses over the left group and branches off to the canopy, as shown in figure 4–16; pass this line around and behind the pack and harness, depending on the type of parachute, from the left to the right. In fact, the fouled line could not be returned to its group in any other way. Passing the lines around the canopy is NOT recommended.

In order to follow these recommendations for removing fouls, it would be advisable for the beginner to lay out a parachute and practice these procedures step by step.

THE LEFT METHOD.—When a single suspension line from the left group is entangled in the right group, proceed to remove the foul as follows:

Grasp the suspension line belonging on the left side at the point where it crosses over the right group and branches off to the canopy, as shown in figure 4–17; pass this line around and behind the pack or harness, depending on the type of parachute, from the right to the left. The fouled line CANNOT be returned to its proper group in any other more logical way.

Instead of removing one line from the right group which is entangled in the left, try removing two, three, etc., until any number of "rights and lefts" can be removed. It takes practice to sight and remove entanglements quickly.

Set up any series of entanglements. You will soon learn to follow a few simple rules, namely:

1. If the lines are knotted, the knots must be removed first.
2. The "rights and lefts" must be removed before any of the simplest entanglements described earlier and illustrated in figure 4–14 can be removed.
3. Attack one group at a time. First a left and then a right. Work from the pack, grasping the fouled line or lines closest to the pack. Any number of lines can

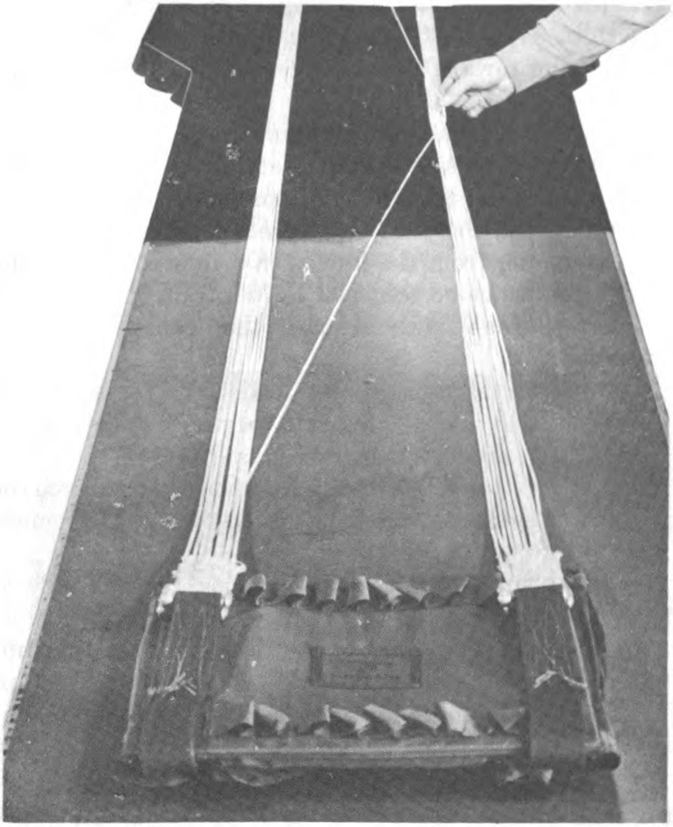


Figure 4–17.—Grasp the fouled line where it crosses over the right group and branches off to the canopy.

be passed at the same time provided they are all situated together.

4. Check the suspension lines for clearance to the top gore of the canopy containing the nameplate. The nameplate must be readable from the outside of the gore, if the canopy is not inside out.
5. Once the lines are cleared completely, check the rotation of the lines around the canopy as described in chapter 3.

Figure 4–18 illustrates the method of removing the entanglements caused by the canopy or harness after they have

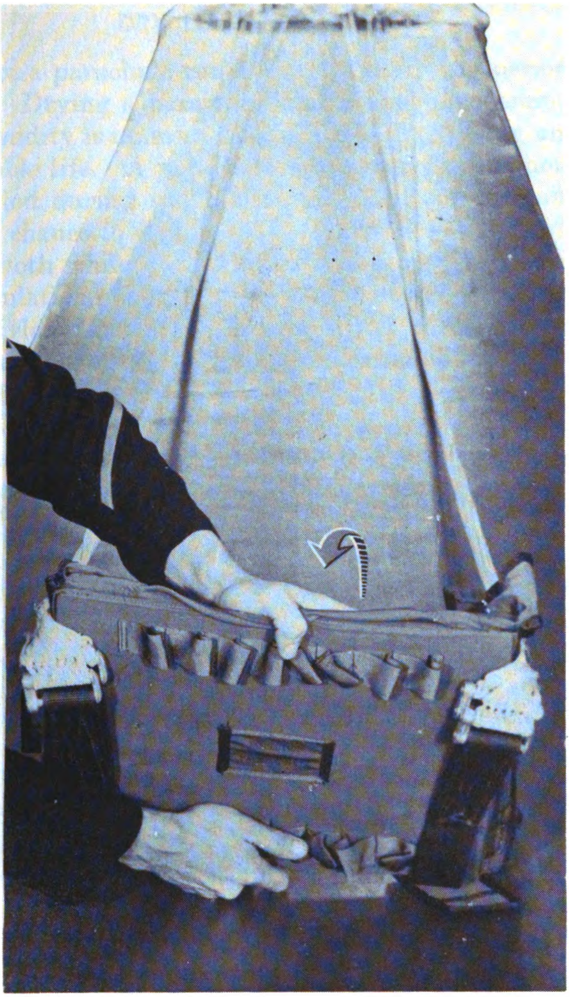


Figure 4–18.—Removing the simplest entanglements last. When the foul comes off between the groups (in), turn the pack DOWN. When the foul comes off outside the groups (out), turn the pack UP.

passed directly between the dividing groups of lines, as illustrated in figure 4–14.

Remove the simplest entanglements last by turning the harness and pack between the dividing right and left groups

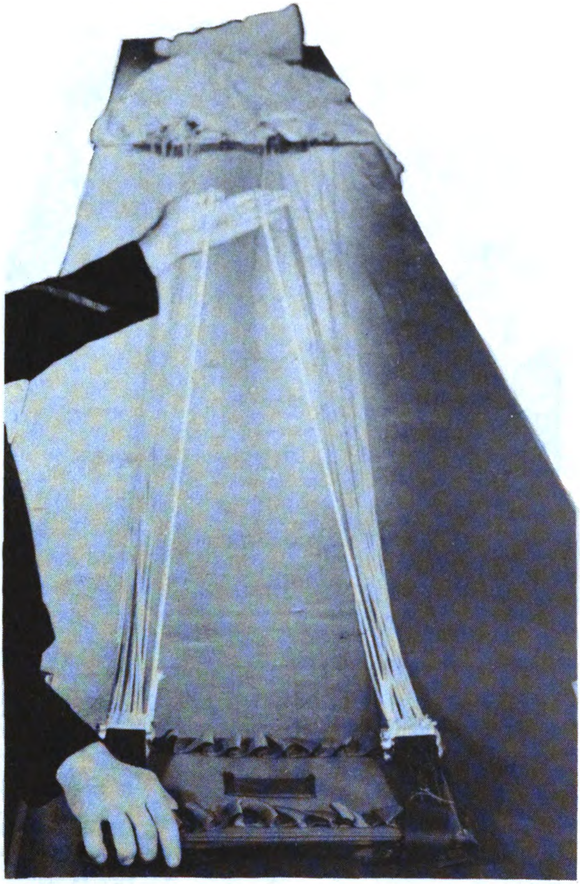


Figure 4–19.—Checking for entanglements; lines clear.

in the opposite direction from which they were made. There may be any number of fouls caused by the forward or backward somersaults of the harness or canopy. Four forward fouls will require four backward turns to remove them, and vice versa.

Figure 4–19 illustrates the two top inboard lines clear and running free from the links to the canopy.

DRY LOCKER PROCEDURE

Before a parachute can be packed, a drying period is essential. Drying a parachute under controlled temperature and humidity is necessary for positive functioning and long serviceable life. A parachute must undergo a 24-hour drying period during which time the fabric of the canopy is given a chance to air out. The sharp creases and folds set in the cloth while packed literally disappear as a result of the circulation of air and the weight of the hanging assembly. Nylon fabric is hygroscopic and therefore gives off and takes on moisture from the surrounding atmosphere.

The following steps are recommended as good dry locker procedures:

1. Maintain a schedule so as not to take up space for a needless length of time. Do not use the dry locker as a warehouse.
2. If possible, arrange to have parachutes ready for packing when they leave the dry locker. Perform any repairs required before hanging the parachute.
3. Stencil parachutes as prescribed. Proper identification is important in their accounting.
4. Avoid scattering; when possible, group parachutes in one or two sections of the dry locker.
5. Keep the canopy and lines off the floor. Place the harness and pack on a smooth topped table.
6. Avoid hanging more than one parachute to a line. A parachute should have a minimum of 2 square feet (plane) for drying space.
7. Avoid unnecessary opening of doors in an air-conditioned dry locker.
8. Do not hang wet parachutes in the same space with dry parachutes.

Readying the Parachute Prior to Suspension

There are several ways to prepare a parachute for the airing and drying or rejuvenation period. The physical layout of the loft dictates part of your routine; this subject will be described in chapter 6. It is a good practice to inspect the parachute prior to hanging it. Packing can then proceed without interruption. When possible, inspect and repair the parachute one day, dry it, and pack it on the following day. The *Parachute Manual*, NavAer 13–5–501, sets forth acceptable drying periods for emergency conditions.

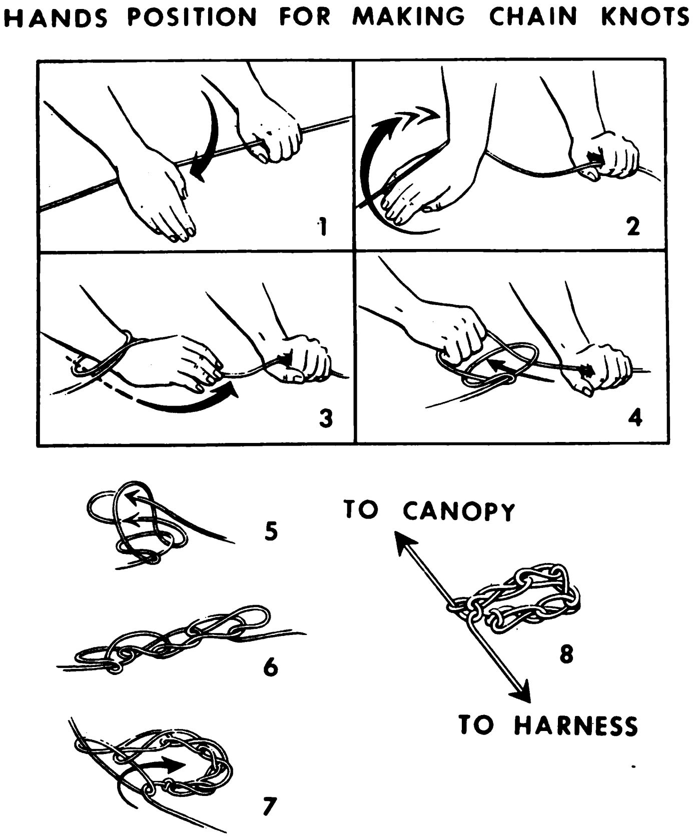
In the event a table is not available for inspection and repair prior to airing the parachute, the following procedure is recommended and may be performed under the hoisting line:

1. Release the pack opening bands and secure the free ends to prevent them drawing back out of reach.
2. Pull the ripcord to release the canopy. Secure the grip to a harness snap temporarily for safekeeping.
3. Attach the snaphook, or similar fixture, of the hoisting line to the peak of the canopy through the suspension lines.
4. Raise the canopy to shoulder level, grasp the skirt, and proceed to shake out the folds. The vane type pilot chute will take care of itself. It cannot be held in a compressed state.
5. In the event the dry locker is not high enough to accommodate the canopy and suspension lines at full length, it will be necessary to chain the suspension lines and secure the harness and pack off the floor.
6. After the airing period, lower the parachute directly on to the pack, faking the lines and cloth gently while preventing contact with obstructions or the deck.
7. Always carry an unpacked parachute carefully. Do not permit the cloth to become snagged on rough surfaces. Always check the cleanliness and smoothness of any surface before setting a parachute down.

The temperature and humidity ranges will be given in chapter 6 along with a complete study of the physical layout of the dry locker.

KNOTS USED IN PARACHUTES

Study figure 4–20. It illustrates chaining the suspension lines. Chaining shortens a line and prevents damage and entanglement of a line.



HANDS POSITION FOR MAKING CHAIN KNOTS

Figure 4–20.—Steps in chaining lines.

Figure 4–21 illustrates the method of tying the overhand knot, the square knot, the bowline knot, the surgeon's knot, the fisherman's knot, and the half hitch. These knots are in constant use. A tacking knot is a surgeon's knot; however the fisherman's knot may be substituted in places where the tacking will be subjected to more frequent stress and handling.

The clove hitch and half hitch are used at the removable connector links to secure the ends of the suspension lines. Since this involves a major repair, they are not illustrated.

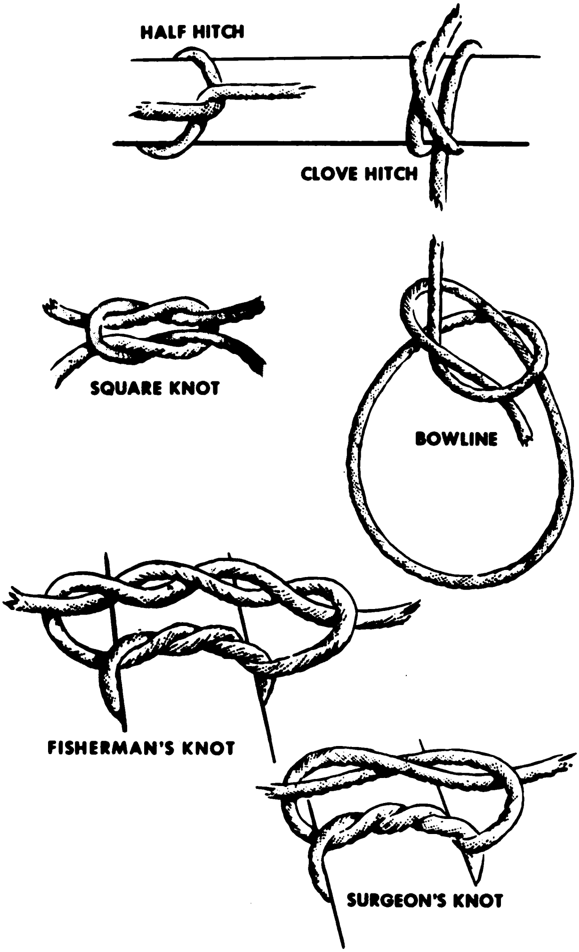


Figure 4–21.—Knots.

Half hitches are also used to secure the safety tie around the locking pin of a ripcord.

FUNDAMENTAL STEPS IN PACKING

Following is a list of the basic steps to be used in packing a parachute:

1. Clean the table.

2. Lay out tools and equipment.
3. Lay out parachute.
4. Inspect and repair harness tackings if damaged.
5. Hook up and continue inspection of the canopy and suspension lines under tension.
6. Whip and fold canopy.
7. Unhook the parachute. Sign the inside Parachute Record Card.
8. Stow suspension lines.
9. Place canopy on pack.
10. Position pilot chute.
11. Partially close pack.
12. Completely close pack.
13. Safety tie locking device.
14. Hook up opening bands.
15. Make test and adjustments.
16. Sign the outside Parachute Record Card.

The packing interval is once every 60 days or more often as conditions dictate. A visual and recorded external inspection is required every 10 days. Seat type parachutes, rigged with the pararaft kit, may require more frequent repacking than other types, due to the additional weight of the kit and the position in which this type parachute is worn.

Packing and Rigging the Chest Type Parachute

The chest type parachute (28-foot, ripstop, nylon canopy and quick fit harness without the raft attachment) will be discussed first because it is the simplest and easiest to pack and rig. All other Navy parachutes are packed approximately the same as the chest type parachute. Later, in discussing the variations of packing and rigging, reference will be made to the "QFAC" where similar operations are encountered.

One man can pack a standard service type parachute. However, the two-man packing team can effectively PACK a parachute in an average time of 8 minutes. You will notice that the emphasis has been placed on PACK since the time quoted does not include any of the rigging processes.

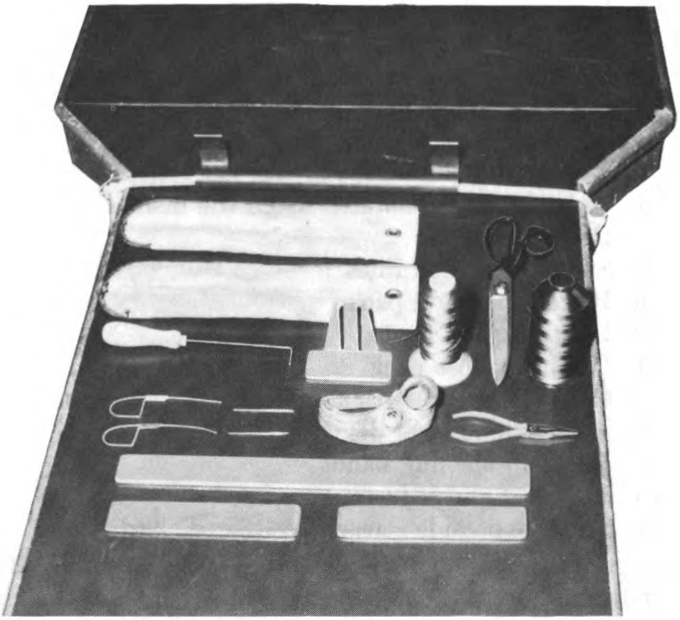


Figure 4–22.—Tools and equipment in position, ready for packing.

The following steps are recommended methods for packing and rigging the chest type parachute:

1. Clean the table so that abrasives or other foreign matter will not come in contact with the parachute.

2. Lay out the packing and rigging tools. Packing tables are generally fitted with a tensioning device to hold the parachute during certain stages of packing. These should also be in position. (See fig. 4–22.)

3. Lay out the parachute. The lift web assembly, in this case, is not tacked to the pack as this step is to be demonstrated. It is not always necessary, prior to packing, to break and remake the tackings that go together in the rigging of certain appendages. We are starting from the unrigged condition so that all the rigging problems can be adequately covered. After the parachute has been packed and rigged properly, it can remain in service indefinitely before it becomes necessary to reattach an appendage or make another

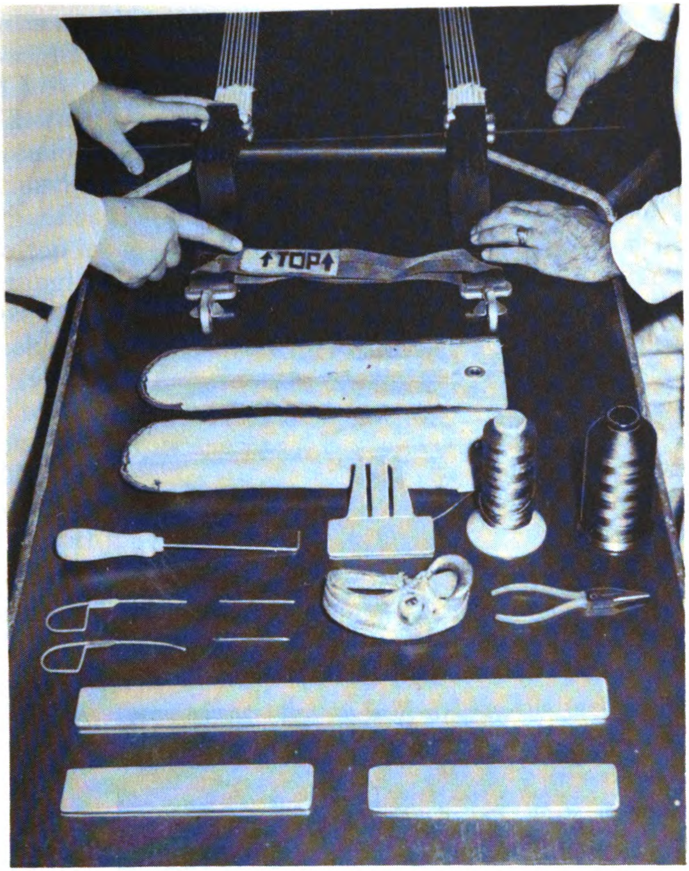
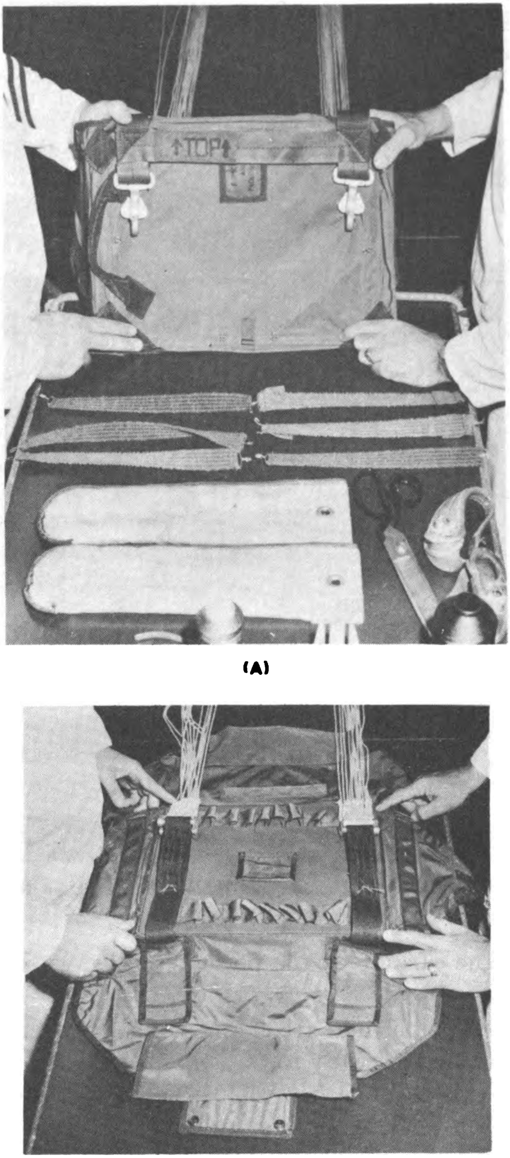


Figure 4–23.—Parachute laid out on the table. Packer is on the left, helper is on the right.

tacking. The care given the parachute always shows up in the inspection.

If the suspension lines are chained, slip the securing hitch as the helper makes ready to pull the peak to the end of the table. As this is done, the suspension lines unchain, and by the time the peak of the canopy has reached the end of the table, the suspension lines will be completely free. Figure 4–23 illustrates the proper atitude of the lift web assembly, preparatory to assembling it to the pack. The packer's sta-



(A)

(B)

Figure 4–24.—Position of lift web assembly in relation to pack. (A) Outside view; (B) inside view.

tion is on the left side of the table, the helper's station is on the right side. (This is viewing the table from the packing end.)

Check the assembly for entanglement. Make sure that the canopy is turned right side out, that the lift web assembly is constructed properly and contains no twists, and that the suspension lines are free from fouls. A quick check of the two top inboard lines, as described under "Suspension Line Entanglements," and "Removing Entanglements," will complete the check. Hook up the lift webs to make a quick check of the suspension lines. The helper can hold the peak of the canopy and observe the position of the nameplate on the top gore while the packer lifts the two top inboard lines from the opposite end of the assembly.

The tongues of the quick connector snaps of the lift web assembly should be up (fig. 4–23). Note the stencil marking TOP with arrows on either side; cross connector straps carry this information which is intended to aid the wearer in connecting the parachute to his harness.

To attach the pack to the lift web assembly, position as shown in views (A) and (B) of figure 4–24. To make the BREAK TACKING refer to figure 4–25, where the tacking pattern is illustrated.

The chest pack lift web assembly tacking must be very strongly made, as this attachment must hold the pack securely while the parachute is being worn and at the crucial time of

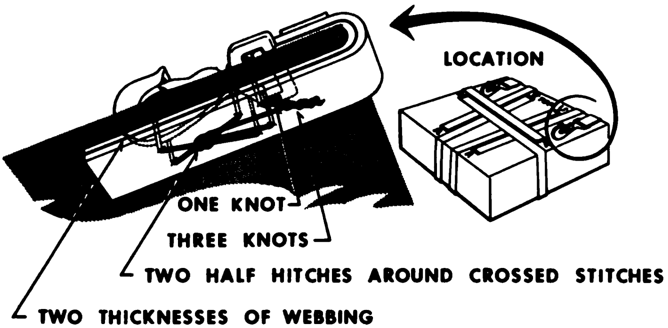

LOCATION
ONE KNOT
THREE KNOTS
TWO HALF HITCHES AROUND CROSSED STITCHES
TWO THICKNESSES OF WEBBING

Figure 4–25.—Chest type parachute, lift web and pack tacking.

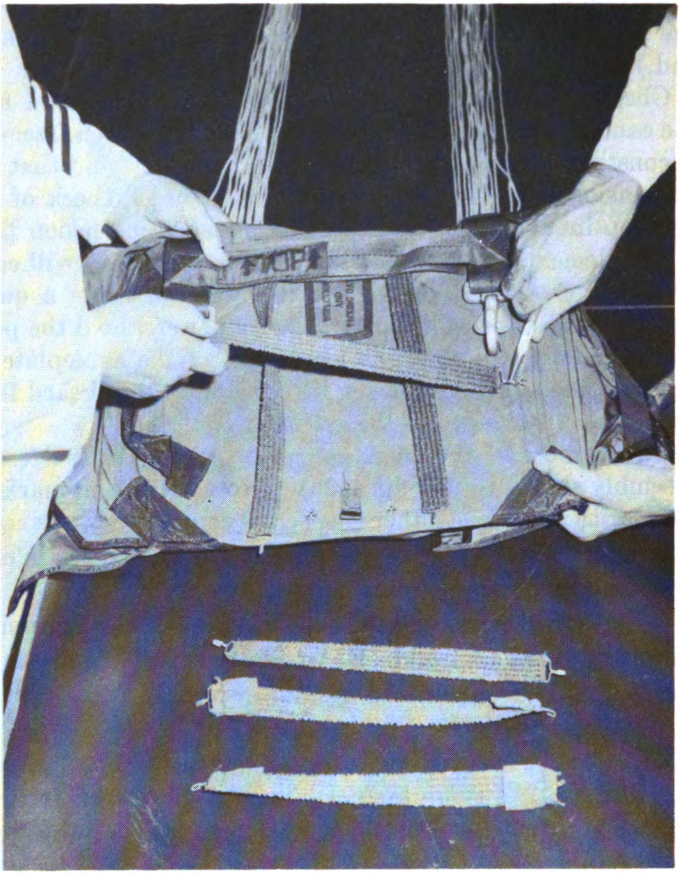


Figure 4–26.—Pinch the tips of the pack opening band hooks closed, to prevent loss.

egress from the aircraft. Do not tolerate a sloppy tacking. The quick connector snaps are meant to be held in place rigidly, thus facilitating "hookup" to the harness. Since this is the strongest "break tacking" used in service parachutes and must support the pack as well as break away, it is important that this tacking be drawn up tightly to prevent slippage, as shown in figure 4–25. After completing the lift web tackings, attach the pack opening bands to the pack. Use a pair of flat nose pliers to pinch the hook ends closed after they have been passed through the wire anchoring eyes of the pack. This will prevent loss of the pack opening bands. When only one end is hooked up as in packing, airing and drying, or at any other time, the parachute is inactive and unpacked. (See fig. 4–26.)

4. The inspection process actually involves inspection in two conditions: (1) when the parachute is not under tension; and (2) when the parachute is under tension. When the parachute is not under tension inspect the harness, lift webs, and all appendages, including sewing and tackings; also the pack and all appendages, including tackings.

When the parachute is under tension inspect the canopy (all sections, sewings, seams, and hems); suspension lines and all security points; and the pilot chute connection.

Inspection during the latter condition is carried out after the parachute has been hooked up. When time permits, remember it is the best policy to hold a complete inspection making all minor repairs before hanging the parachute in the drying locker. In this way the packing process can be accomplished most expeditiously.

When the inspection process must be carried out at the same time as packing, due to scheduling problems, lay the parachute out on the table but do not hook it up.

Since there is no tension applied to the assembly, one will have all the freedom necessary to carefully inspect the pack, harness, and the other small appendages. The harness and pack parts of the parachute receive the most wear. The canopy, if properly cared for, will last longer than the other assemblies. After the preliminary inspection which is conducted at the harness end of the parachute, the entire assembly may be placed under tension and the canopy, suspension lines, and pilot chute may be given a final check. If damage to the canopy is discovered, it will be necessary to unhook the parachute and repair it, if possible.

5. Hook up the parachute. The packer passes the flat hooks of the spreader bar up through the connector links as the helper grasps the peak and walks to the opposite end of the table. When the hooks are in place and the spreader

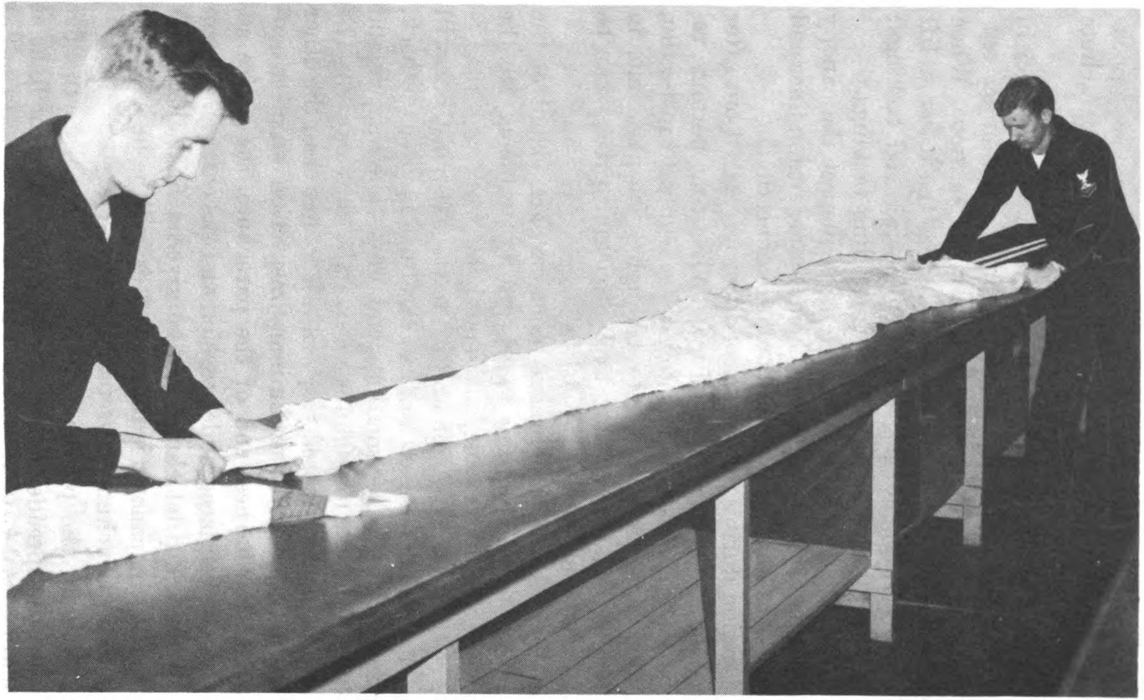


Figure 4–27.—Straightening the skirt hem.

bar is secure, the helper applies a certain amount of tension at the peak prior to straightening the skirt hem. This operation is accomplished by manipulating the suspension lines at the peak while the packer directs the operation from the skirt of the canopy (fig. 4–27).

A perfect alignment of the skirt and vent hems is not always possible. One gore may be slightly longer than the other; the one-half inch of slack given the canopy at the skirt and over each suspension line may vary. Straighten the skirt, and if necessary, let the vent hem take the slightly irregular setting. Every effort should be made to straighten the skirt properly, and if an irregular alignment of the folded hem edges is too pronounced, turn the parachute in for major repairs.

Adjust the tension on the parachute to the point where the skirt hem can be raised to shoulder level without strain-

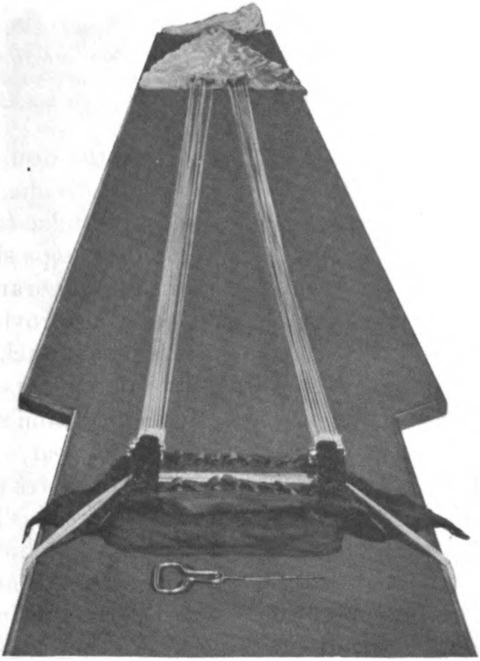


Figure 4–28.—Chest type parachute under tension and ready for packing.

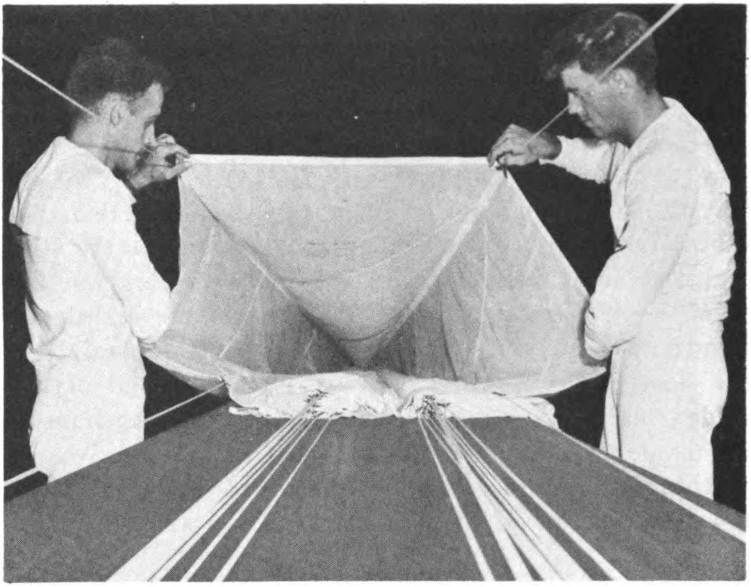
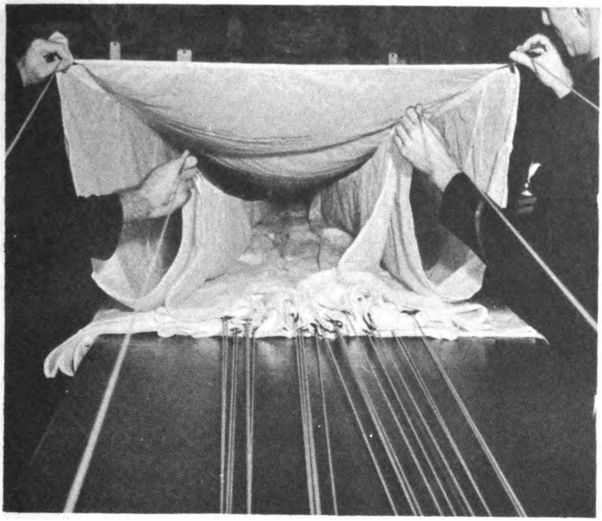


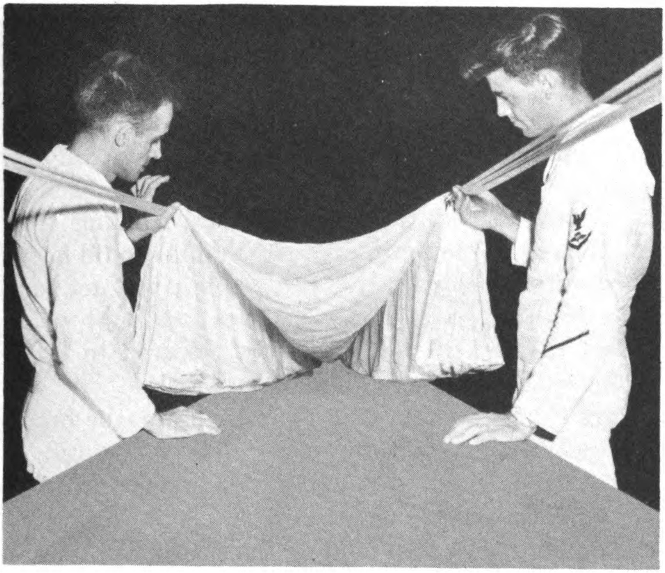
Figure 4–29.—Packer and helper in position to whip and fold the canopy. Note action of each man's lower hand which draws the next suspension line away from those gathered in the center of the table by the applied tension.

ing. Experience is the best teacher, as the desired tension will vary with the parachute and the individual. Figure 4–28 illustrates the chest type parachute under tension and ready for packing. All of the inspection steps should now be completed. Notice the seat cushion temporarily placed between the pack and table. This padding provides a good packing base which prevents the hardware tackings from loosening and the surface of the table from being scratched.

6. Whip and fold the canopy. This operation reduces the unwieldy area of the cloth to a series of neat, consecutive folds. The packer and helper station themselves at opposite sides of the table and in line with the skirt hem. The packer will have two shot bags and a suspension line holder to aid him in neatly holding the folds of the canopy together after completion of this operation. The holder and bags can be placed near the edge of the table where they will be out of the way.



(A)



(B)

Figure 4–30.—Whip and fold each gore until all of the suspension lines have been taken up by the packing team. (A) First fold being made; (B) all folds made except top and bottom.

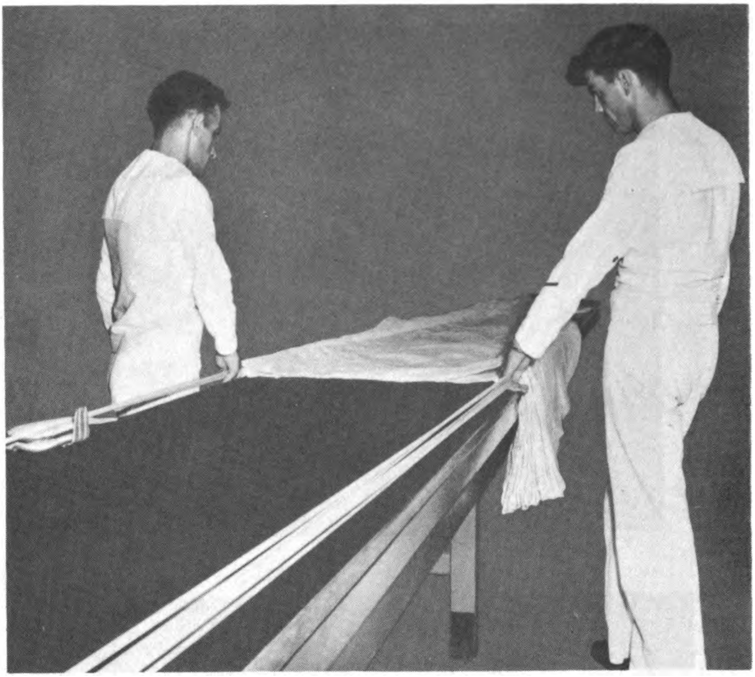


Figure 4–31.—Step I in completing the last two folds.

In beginning the operation, grasp the two top inboard lines (on each side of the top gore), glancing back at the links to make certain that the lines are running free and clear. The complete continuity of the lines should have been checked during the inspection process so it will not be necessary to do this again. Raise the lines to a level where the inside of the canopy can be clearly observed to the peak. (See fig. 4–29.)

Figure 4–30, views (A) and (B), illustrates the folding of each gore or section, except the top and bottom gores.

In making the last two folds in the top and bottom gores, swing the folded gores out beyond the table (fig. 4–31).

The packer, while still holding the suspension lines in his right hand, reaches over the suspension lines with his left hand to the top center area of gore number 28 and prepares to draw a fold back over to his side of the table. The helper

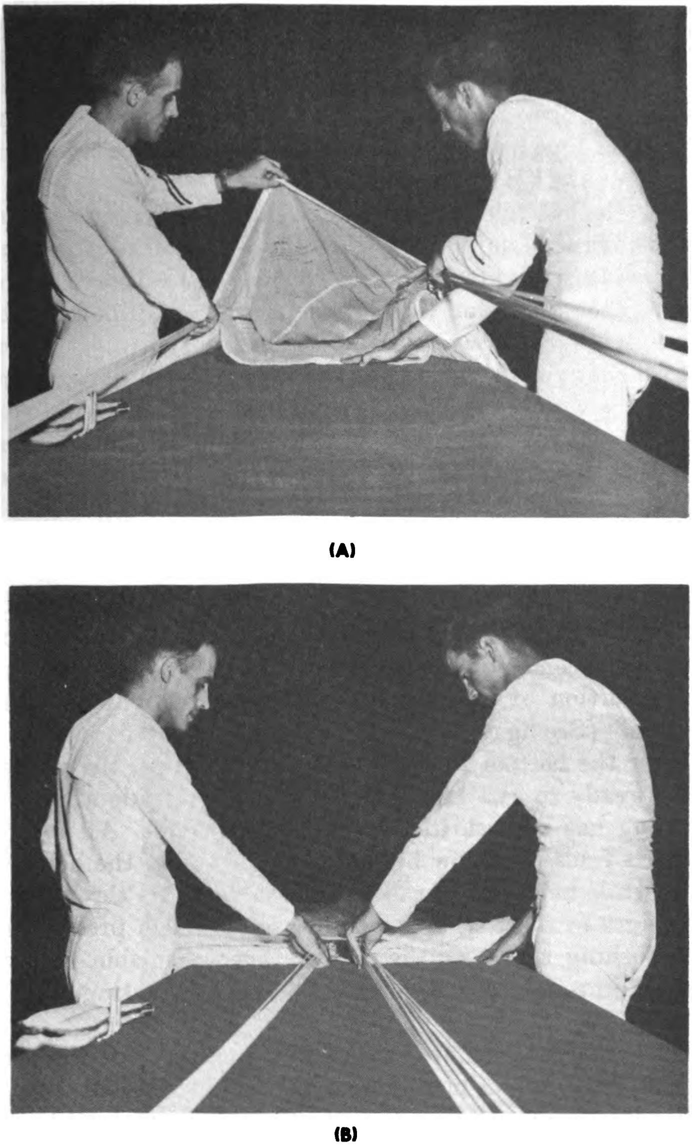


Figure 4–32.—Step II in completing the last two folds. (A) Gores being grasped in the center prior to moving lines to center of table and edges of folds to outer edges of table; (B) lines brought to the center and skirt hem folds brought out in the opposite direction.

does the same with the bottom gore, but must reach under his group of lines preparatory to drawing the bottom fold back to his side of the table. On signal they both draw the folds in opposite directions while at the same time bringing the suspension lines to the center of the table. (See fig. 4–32, views (A) and (B).)

Since the last fold on the helper's side has to be made from the bottom, it is quite likely that the fold will need special attention to straighten it throughout its entire length to the peak. The suspension lines of each group may now be inserted in the respective slots of the suspension line holder. The packer now places a second shot bag across the skirt hems on his side while the helper casts all but one of his folds over on top of the packer's side. Note the shot bag placed across the suspension lines for the purpose of retaining the lines in the suspension line holder.

Action is now begun to straighten the bottom fold and bring it out to the proper taper throughout its run to the peak. The packer may follow the helper or remain at his station throughout this operation, holding the suspension lines to the center of the table while permitting the tucked-under portion of the bottom fold to be brought out into position. (See fig. 4–33.)

After the bottom fold has been straightened, the packer makes ready to cast his folds to the helper's side after the shot bag has been shifted to the other group. All of the packer's folds may now be cast over on top of the helper's folds while he quickly brushes out the wrinkles throughout the length of the section. Do not use too much pressure in the brushing action or the fold on the other side will be brought through and require a complete recasting. (See fig. 4–34.)

The packer's folds are returned to their side of the suspension lines and the brushing action is again applied to both sides of the canopy folds. The shot bag lying on the helper's folds is removed and placed at the edge of the table. Figure 4–35 shows the canopy after all of the folds have been completed.

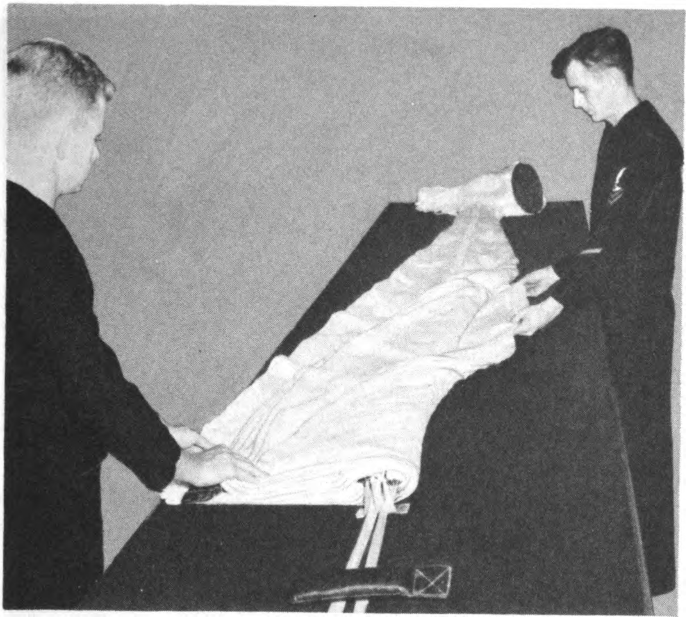


Figure 4–33.—Step III in completing the last two folds.

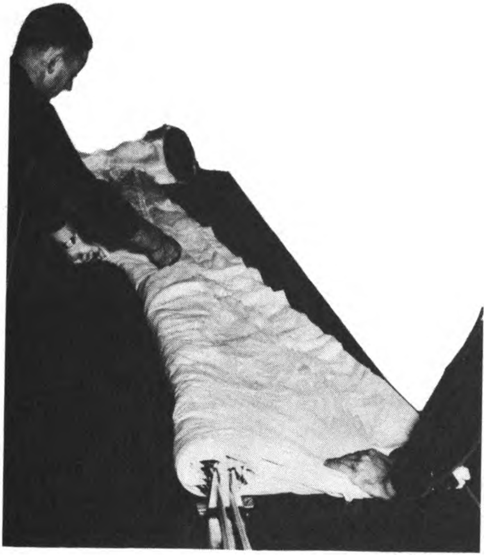


Figure 4–34.—Step IV in completing the last two folds.

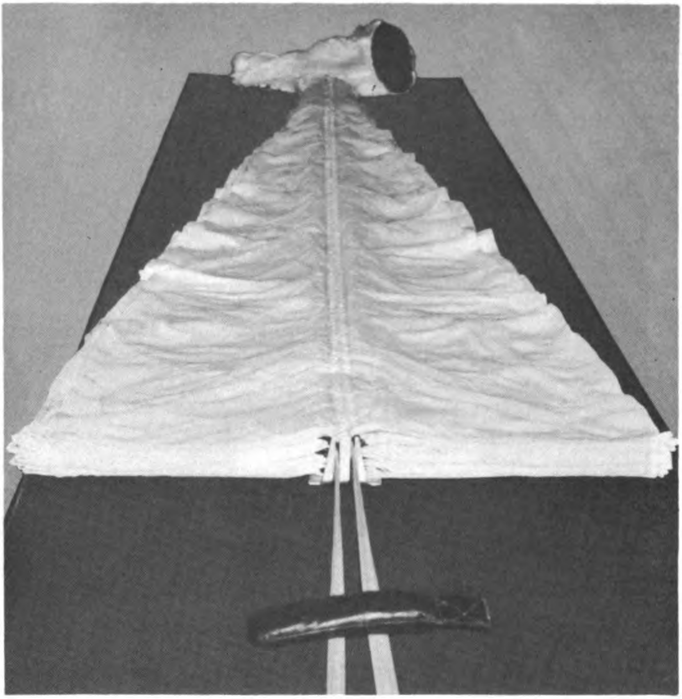


Figure 4–35.—All whipped folds completed.

There are a number of other reliable methods that may be applied in making the last two folds. Experience enriches the fundamentals of any technique. Some Riggers believe that the only real way to pack a parachute is to do it by themselves. The novice at parachute rigging has to learn and practice all of the basic steps and principles of packing a parachute before he can safely be on his own. Develop accuracy first and speed second.

To straighten the skirt hem, grasp the folds of the skirt at the corners and fold back, as shown in view (A) of figure 4–36.

Align and count each fold until they are all neatly in place. Each group on either side of the suspension lines should have fourteen folds. (See fig. 4–36, view (B).)

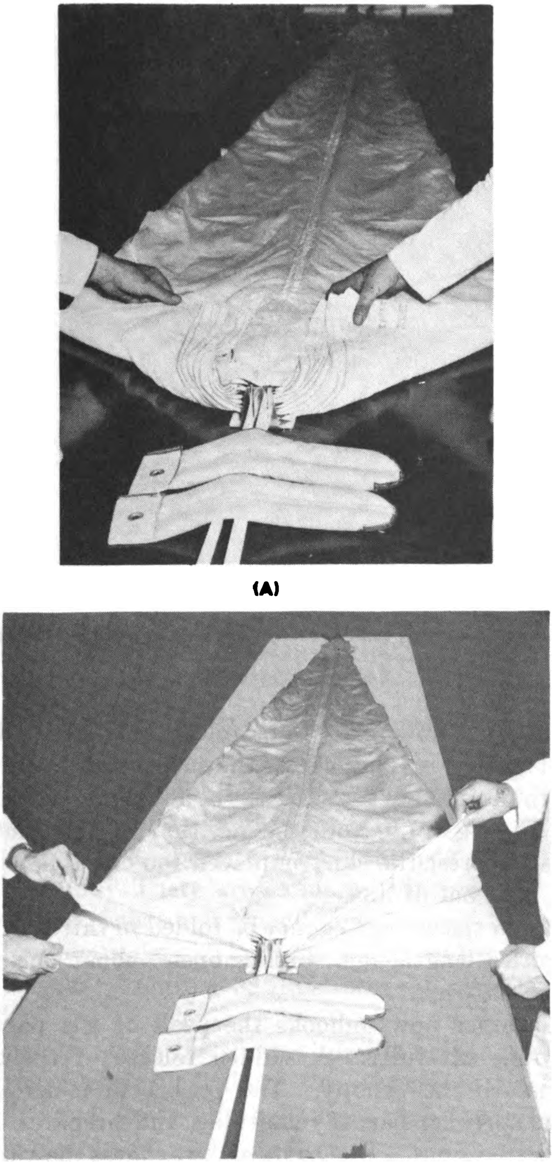


Figure 4-36.—(A) Skirt folded back preparatory to straightening. (B) Straightening skirt.

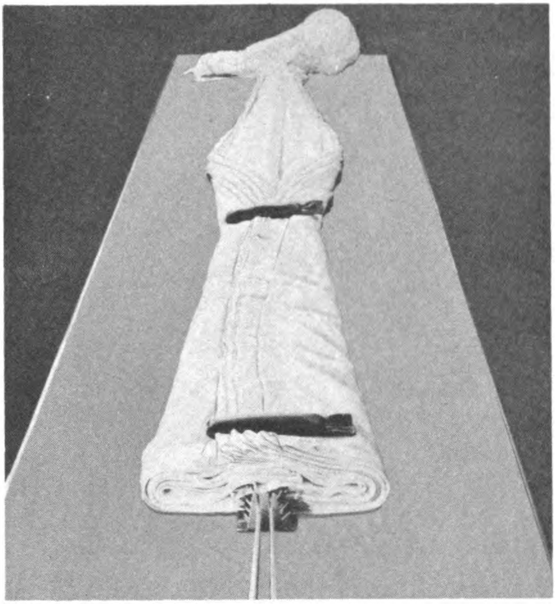


Figure 4–37.—Canopy folded in thirds and held in place by shot bags.

The canopy is now ready to be folded in thirds. Remove the shot bag that is lying across the suspension lines. Take care not to disarrange the skirt as the folds are brought into position (fig. 4–37). Note the position of the shot bags. If the bag nearest the skirt is placed too close, it will pull the skirt back out of line.

Notice that the canopy cannot be folded in thirds throughout its entire length, but "breaks open" about one-half of the way to the peak.

7. The helper now unhooks the peak of the parachute. This is done carefully. A sudden release of the tension would disturb the canopy. The packer unhooks and removes the spreader bar, if removable, and prepares to stow the suspension lines. Due to its awkwardness the vane type pilot chute will not stay on the table as the canopy is pulled down to the pack. Before taking his station the helper

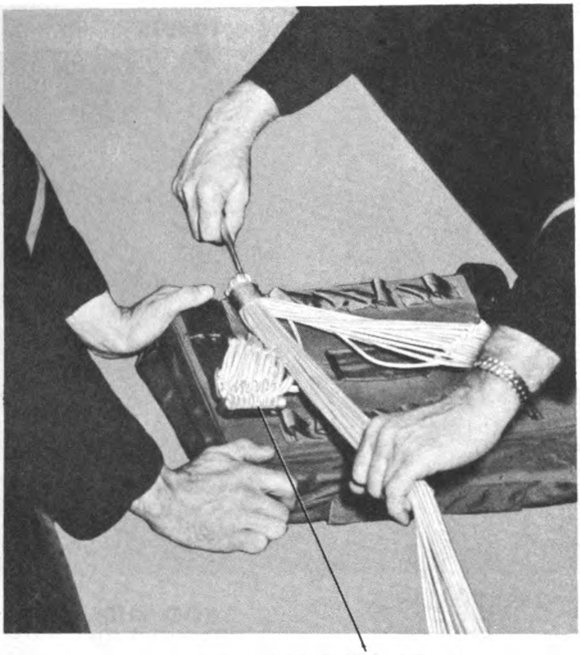


Figure 4—38.—Common errors in stowing suspension lines.

places the pilot chute on top of the canopy. Sign the inside Parachute Record Card and insert it in the pocket.

8. Stowing the suspension lines is the most difficult operation of the lot. There are so many things to watch for—dropped lines, twists, uneven stowage, tearing the pack, tearing or turning under the hesitator loops, and improper gaging of length. Figure 4–38 illustrates the pitfalls to guard against.

The packer stows the lines while his helper prevents the pack from shifting. Taking the suspension line hook in the right hand, grasp all of the lines with the left hand, as shown in figure 4–39.

Bring the lines in a bight up to the first hesitator loop. Using the suspension line hook, henceforth referred to as

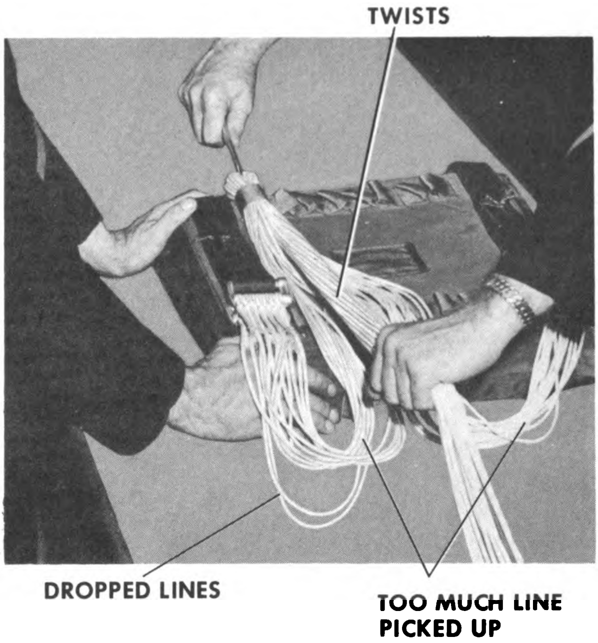


Figure 4–38.—Common errors in stowing suspension lines. (Con.)

the hook, draw the lines through the first hesitator loop and about an inch beyond the edge of the loop. (See fig. 4–40.)

The beginner should practice the procedures illustrated in figures 4–37 and 4–40 until he can gage the correct amount of lines to stow in the first hesitator loop and bottom of the pack. This operation is important. If too much line is stowed in the first bight, you will not be able to use all of the hesitator loops, and the length of line left between the skirt of the canopy and the last bight in the hesitator will probably be the wrong length. If an insufficient length of line is taken up in the first bight, the lift webs and links may be pulled in toward the center of the pack, and the result will be too much line left between the last bight and the skirt of the canopy. Figure 4–41 illustrates the lines correctly arranged in the bottom of the pack. Notice how the suspension lines leading to the canopy are running free and alongside the

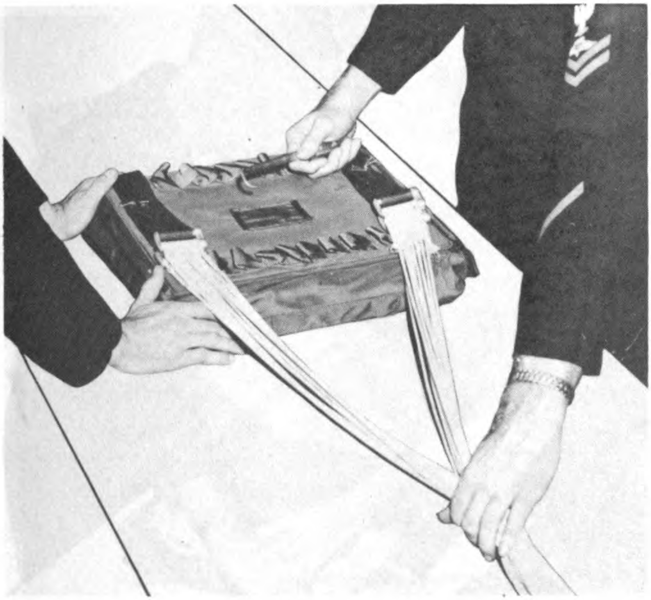


Figure 4–39.—Stowing suspension lines; gaging length (22 to 23 inches).

lift webs. There is no twist here. Take care not to tuck the suspension lines under the lift webs.

The helper should aid you in keeping the pack in the center of the table. He should help keep the pack stable and hold back on the suspension lines as the new bight is being taken. Keep an eye on the canopy to make certain that it is being drawn along in a straight line. The chest type parachute offers no stability problem on the table since there is no harness or pararaft container to tuck under the pack in an attempt to make an even working surface. Caution the helper, in holding the suspension lines, not to draw the bight beyond the position where you placed them. It takes practice on the part of the helper to hold, between his fingers, a bight of suspension lines perfectly in place and not lose one or exert a backward pressure in excess of the packer's hook tension. An experienced Rigger can quickly place a perfect group of suspension lines in a pack if he has a good helper.

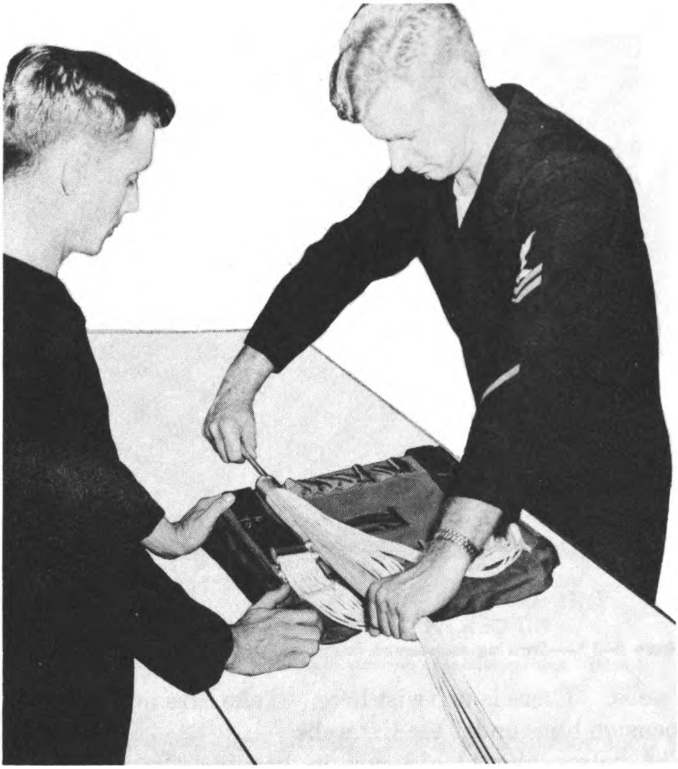


Figure 4–40.—Stowing suspension lines; drawing first bight.

Figure 4–42 illustrates the seventh bight of lines being drawn through the hesitator loop. Notice that there are no twists in the suspension lines and that they present a taut, straight appearance. The novice trying a hand at this operation has a tendency to twist the lines between the bights. This is brought about by not keeping the palm of the hand parallel to the table top when grasping and maneuvering the lines into the hesitator loops. Practice is the best way to bring about perfection.

Once the hook is engaged in drawing the lines through a hesitator loop, do not permit the tip to lose contact with the bottom of the pack. Experience will teach you the right amount of pressure to apply in drawing the lines through the

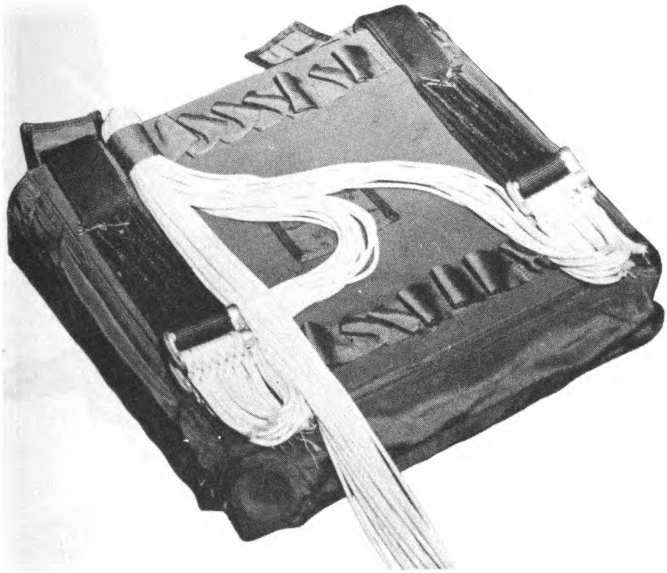


Figure 4–41.—Arrangement of suspension lines.

hesitator loops. No other single step in packing the parachute consumes the time that this does. After the last bight has been placed, check for dropped lines. Check the length of lines between the last bight and the skirt. There should be enough line left to permit the skirt to be brought up to the far edge of the pack, 12 to 18 inches is ideal. Too much length left over invites a "line over" condition when the parachute is jumped.

To correct a dropped line condition pull the suspension lines out of the loops until you find all of the places where they have been dropped. This often results in starting over.

Straighten the hesitator loops with the hook or a temporary locking pin as illustrated in figure 4–43. Remove the tucks or wrinkles created by the action of drawing the tight fitting lines through the hesitator loops. If you don't iron out the wrinkles, they will take a permanent set, and the next time you attempt to draw the lines through a wrinkled hesitator loop it may tear out along the stitching.

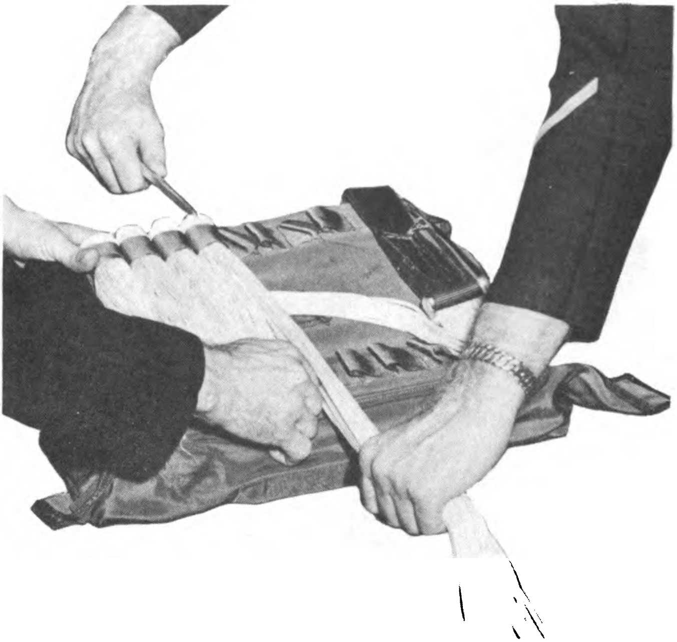


Figure 4—42.—Stowing the seventh bight.

9. The pack is now ready to receive the canopy. Withdraw the sides and ends of the pack that have been tucked out of the way. Turn the pack 90° clockwise so that the suspension lines are in position as illustrated in figure 4–44. The lift web protector flaps are also placed in position over the lift webs.

The suspension lines are arranged to come from the middle of the pack, and the helper holds the long bar over these lines in preparation for the canopy as illustrated in figure 4–45. The first shot bag is removed, also the suspension line holder.

Grasp the skirt, lift, and bring it in a straight line toward the ripcord end of the pack. Stop when directly over the edge of the pack. Be careful not to disarrange the folds or the suspension lines in stowing the canopy. Caution the helper not to hold down or draw back on the long bar during this operation but to follow the motion of the lines. Holding

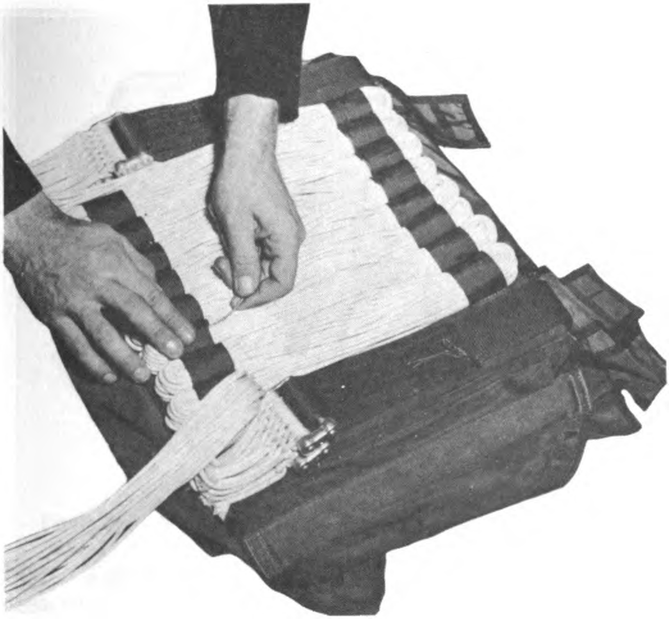
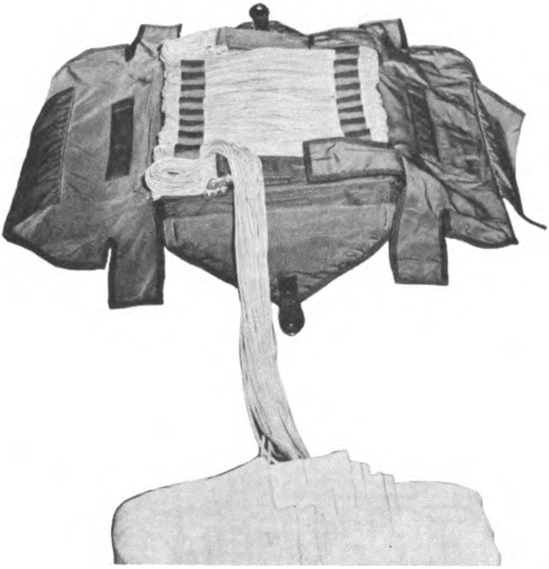


Figure 4–43.—Straightening the hesitator loops.

down or drawing back will cause the skirt to tuck under and may pull the last bight of suspension lines out of the hesitator loop. Drawing back on the long bar may also cause the lines to stick out beyond the edge of the pack. Throughout the entire packing procedure, neatness cannot be overemphasized. Do not permit the last free length of suspension lines between the skirt and the last hesitator loop to become entangled in the lines already stowed or to project from the edge of the pack. Figure 4–46 illustrates the position of the skirt in relation to the edge of the pack.

When the helper is certain that the skirt is in position at the edge of the pack and the suspension lines have not been disturbed, he withdraws the long bar and places it on top of the folded canopy in preparation for the next fold. The packer checks the long bar position for alignment. The bar is held to produce a clean fold over the edge of the frame. If the bar is held out too far from the edge, the fold will be



Figuro 4–44.—The pack is turned and ready to receive the canopy.

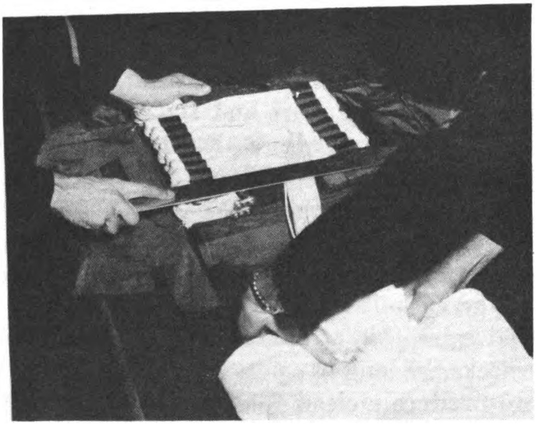


Figure 4–45.—Long bar in place; canopy ready to be lifted onto pack.

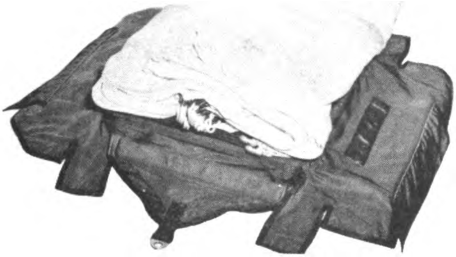


Figure 4–46.—First section of the canopy placed on the pack.

too long. The position of the long bar is important to the neatness of the completed pack. The helper uses his left hand to steady the skirt end at the same time that the first fold is made. (See fig. 4–47.)

Hold the skirt lightly in place (fig. 4–47), taking care not to disarrange the alignment of the skirt hem folds. THE SKIRT HEM IS BULKY. The first fold is brought up to a position just behind the skirt as illustrated in figure 4–48.

The receded fold, immediately behind the skirt edge, provides a reasonably flat surface for the others. As the canopy is folded onto the pack, time is taken to draw the material slightly beyond all edges of the pack for a distance of approximately two inches. This will assure a tight pack when the sides and ends are closed. The packer should give particular attention to the corners. If the corners are not properly filled out with the canopy, they will be soft and will not hold the corner flaps in place. A loose corner of the pack will permit the fabric of the canopy to protrude and become damaged or soiled.

Make certain that the shot bags are removed from the canopy before attempting to make the fold. Always take stock of the tools and equipment as you progress.

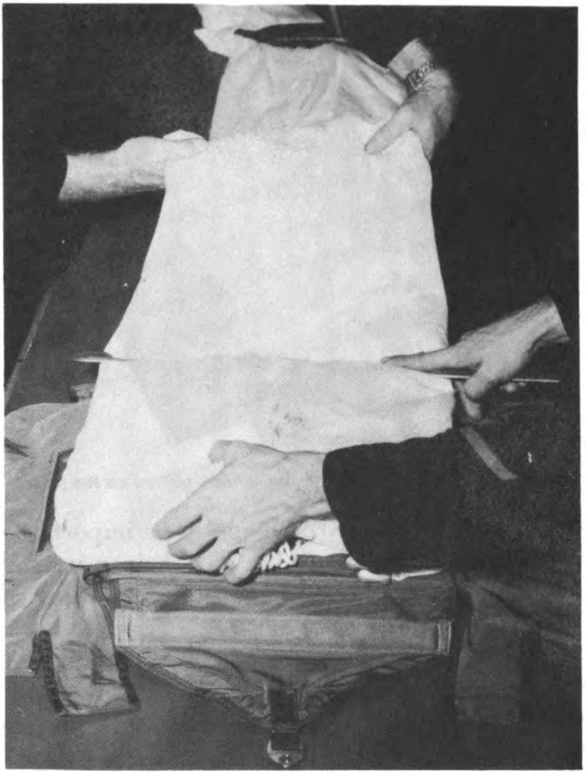


Figure 4–47.—Making first fold.

Bring up the next fold and position it. (See fig. 4–49.) Another fold is made, and then the packer lifts the pilot chute off the peak and the last fold is cast, turning the peak under. (See fig. 4–50.)

10. Turn the pack 90° to the left and prepare to place and compress the vane type pilot chute directly on top of last fold.

Fake or coil the connector webbing on top of the canopy as the helper prevents the canopy from slipping. Position the pilot chute directly in the center of the pack and compress it while guiding the spring in as straight a pattern as possible. Do not tuck the material of the pilot chute canopy

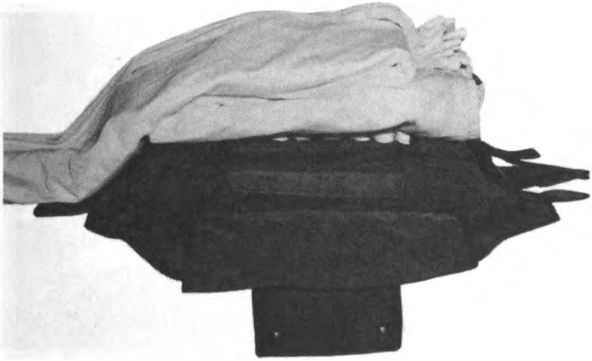


Figure 4–48.—First forward fold placed immediately behind skirt.

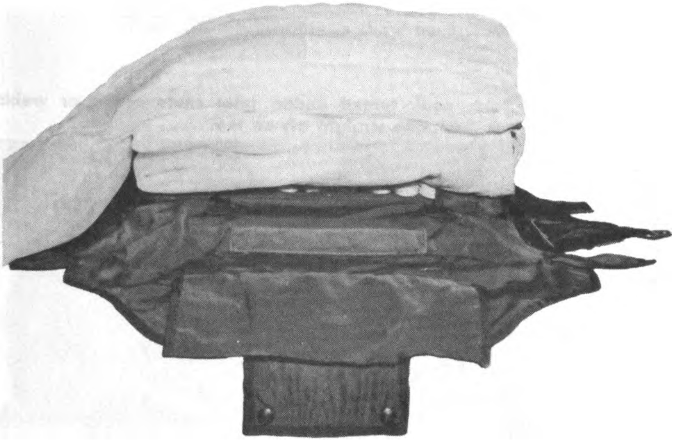


Figure 4–49.—Next fold in place directly over skirt hem.

under or around the springs as it is compressed. (See fig. 4–51.)

11. The packing team holds the pilot chute compressed with their forearms and together grasp the pilot chute protector flap attached to the locking cone side of the pack. (See fig. 4–52.)

As the side is drawn up, prevent the fabric of the canopy from bunching toward the center. Keep it smoothed down by working your free hand between the side flap and canopy.

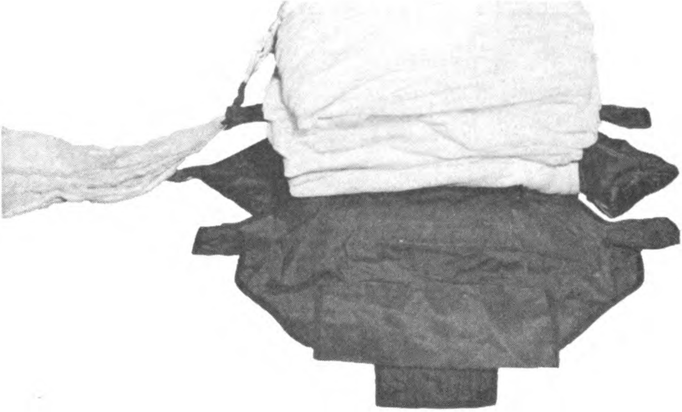


Figure 4–50.—Last fold; peak turned under; pilot chute connector webbing running straight aft on top.

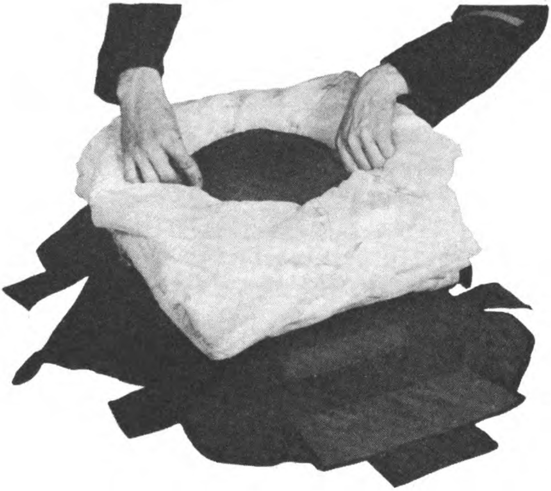


Figure 4–51.—Pack in position to receive vane type pilot chute.

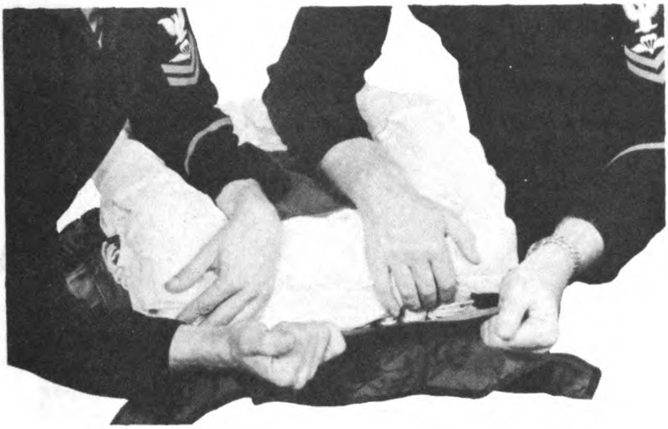


Figure 4–52.—Ready to draw up first side.

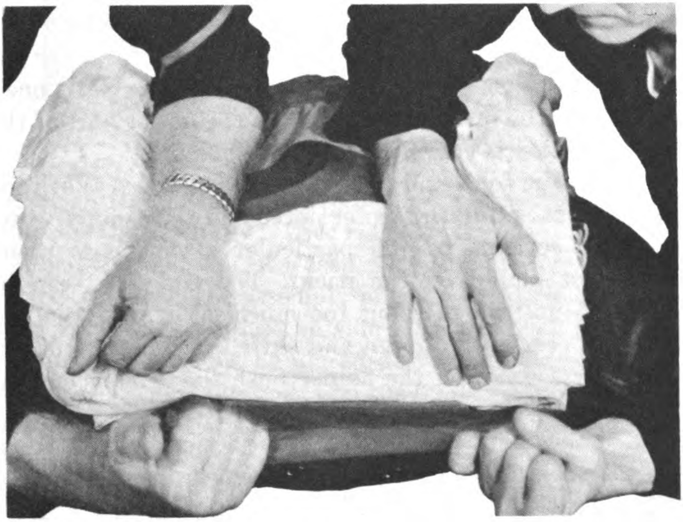


Figure 4–53.—Ready to draw second side closed.

Once the side has been drawn into position, shift around and prepare to pull up the other side while holding the first in place. (See fig. 4–53.)

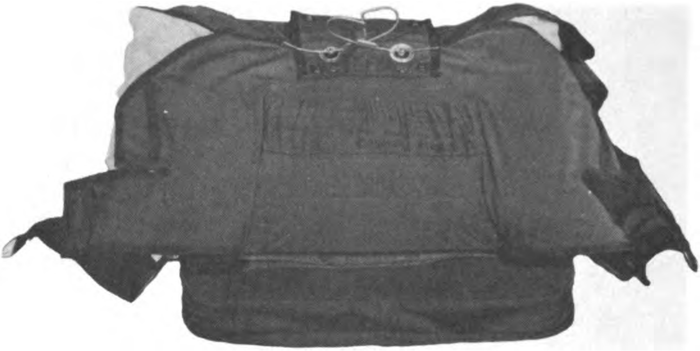


Figure 4–54.—Side flaps drawn up and held in position by temporary locking pins.

Still grasping the pilot chute protector flap attached to the grommet side of the pack, draw the side up to position while keeping the canopy smoothed in place. The grip is shifted, pressure is brought to bear on the assembly, the locking cones are brought into position, the grommets are passed over the cones, and the temporary pins are inserted in the cones. (Note the way the pins are inserted.) The major part of the closing operation is completed. (See fig. 4–54.)

Straighten the folds and corners of the canopy. Work the excess fabric back into the center portion of the canopy. Remember the corners, paying particular attention to them.

12. Do not pound on the pack. The end flaps can be worked into position without too much effort. If the end tab will not reach, straighten and shift the canopy, but not excessively. Do not let the helper push the canopy out the end of the pack when he brings up the end flap.

Many of the operations call for joint action by both members of the packing team. In order to accomplish these steps smoothly, practice is required.

The packer inserts his fingers in the end flap pockets while his helper makes some last minute adjustments to the folds and straightens the lift web protector flap. Grasping the end flap in one hand, the helper pulls it up and over in the direction of the corresponding locking cone while the

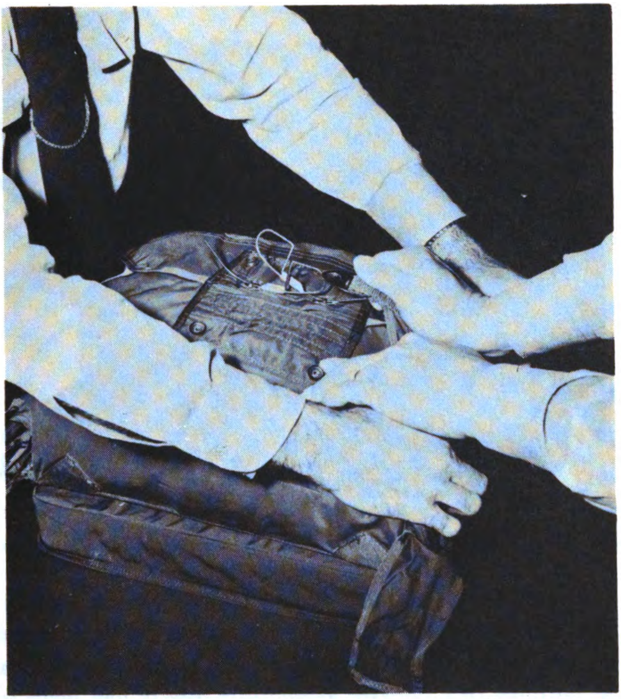


Figure 4–55.—Closing the first end flap.

packer shifts his hands to the outside and exerts pressure to compress the assembly. (See fig. 4–55.)

When the end tab has been brought into position above the locking cone, the assembly must be held closed while the temporary pin holding the side flaps together is removed. The end tab can now be placed down over the cone passing below the ripcord pin hole, and the temporary pin reinserted to hold the side flaps and one end flap together for further packing operations. After gaining experience in closing this end, you may prefer inserting the ripcord and using the ripcord pin, thus eliminating the necessity for two withdrawals of the temporary pin. (See fig. 4–56.)

If the vane type pilot chute has shifted and is not centrally located, you may experience trouble in getting the locking cone passed through the hole in the end tab. This is due

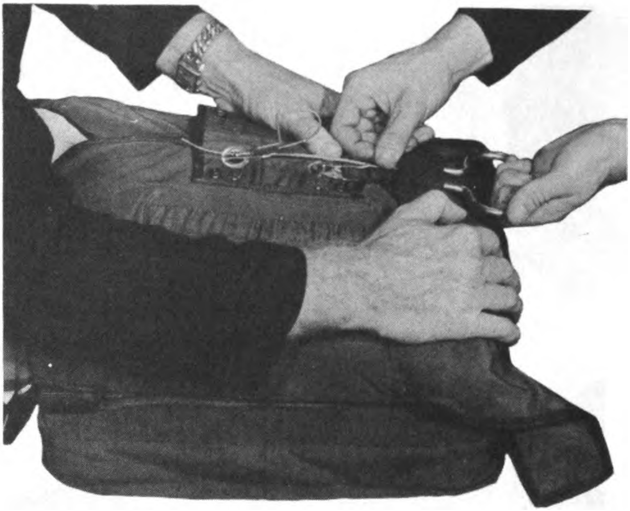


Figure 4–56.—Closing the first end flap and securing the assembly with the ripcord pin.

to the locking cone tilting down and back on the protruding section of the pilot chute spring. The vane type pilot chute should be held in a central position after it has been placed on the canopy and through all subsequent steps until the pack is secured with the ripcord pins. If this uneven condition still exists after the pilot chute has been checked and found to be centralized, there is an indication that the spring is bent or compressed out of line. The remedy for this, of course, is to renew the pilot chute or improve the manner in which you compress the spring.

When exerting pressure on the pack during these closing steps, remember: DO NOT DISARRANGE THE STEPS TAKEN EARLIER IN THE PACKING PROCESS. Exert every effort to improve your technique so that every step from the first to the last can be done smoothly. As a Parachute Rigger, it is your responsibility to make every pack perfect.

The helper inserts his fingers in the end flap pockets while the packer makes last minute adjustments to the end folds of the canopy and straightens the lift web protector flap. As the helper applies pressure to compress the pack, the end

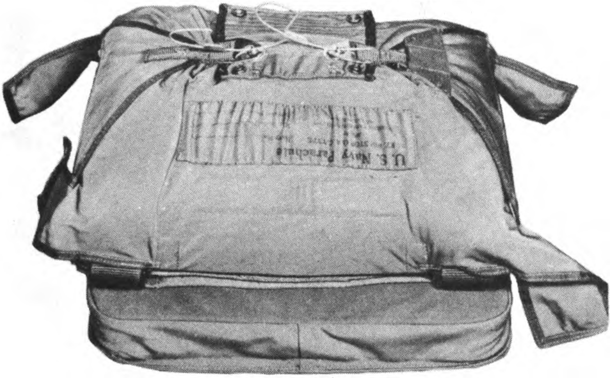


Figure 4–57.—Sides and ends closed and ready for straightening.

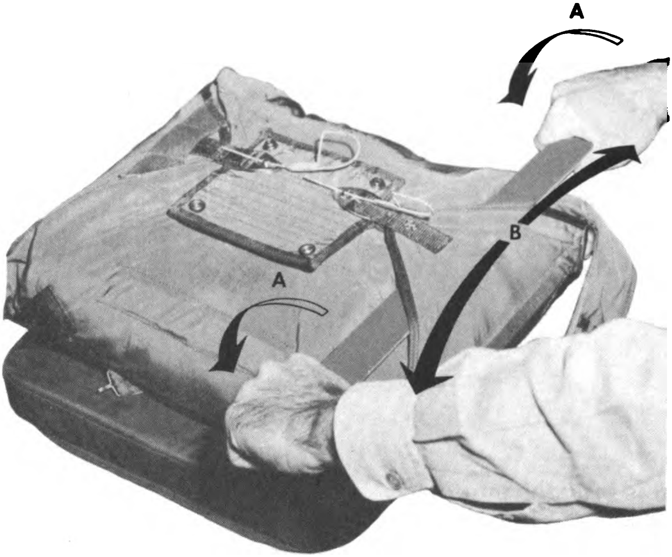
flap is brought into place. The temporary pin is pulled out of the appropriate locking cone and reinserted after the end tab has passed over the cone and everything else is held securely together. The second pin of the ripcord could have been inserted instead of the temporary pin providing, of course, that the ripcord had been used in the beginning. Figure 4–57 illustrates the completion of the closing operation. Temporary pins hold the pack closed prior to straightening.

The long bar is again brought into play. Figure 4–58 illustrates its use in straightening the ends of the pack.

A long bar will not work the side flap ends toward the center of the pack. A fid is used to complete the straightening of the pack. Figure 4–59 illustrates the uses of the fid.

If not previously inserted, the ripcord may at this time be inserted. (See fig. 4–60.)

There are many experienced Parachute Riggers who prefer to engage the ripcord at this time because of the ease in which it passes through the locking cones of a smoothed pack. There is a danger of missing the cones and having to go through the straightening process again, but the experience gained with this method holds such a possibility to a minimum.



A. ARROWS INDICATE ROLLING MOTION

B. ARROWS INDICATE ROCKING MOTION

Figure 4–58.—How to use the long bar to straighten the pack.

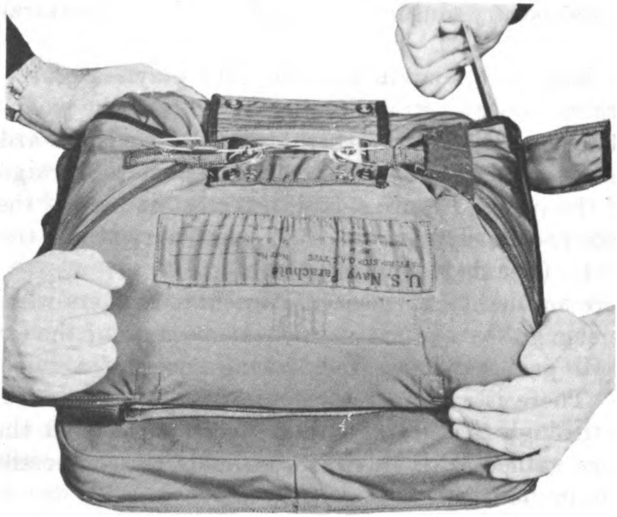


Figure 4–59.—How to use the fid.

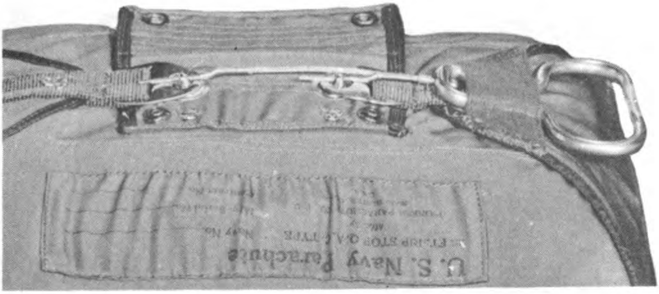


Figure 4–60.—Temporary pins removed and ripcord inserted.

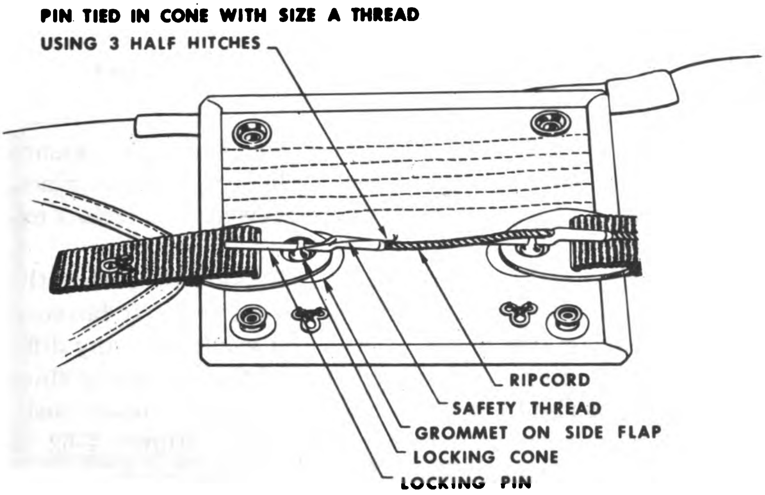


Figure 4–61.—Method of safety tying the ripcord locking pins.

13. Safety tie the ripcord pins with nylon thread size "A." Figure 4–61 illustrates the method of safety tying the ripcord locking pins. The important thing to remember in a safety tie is that it prevents the ripcord locking pins from working out of the cones. A stronger thread or cord would exceed the recommended tensile strength and is therefore dangerous to use.

Generally speaking, a thread having a tensile strength between three and five pounds may be used for a safety tie.

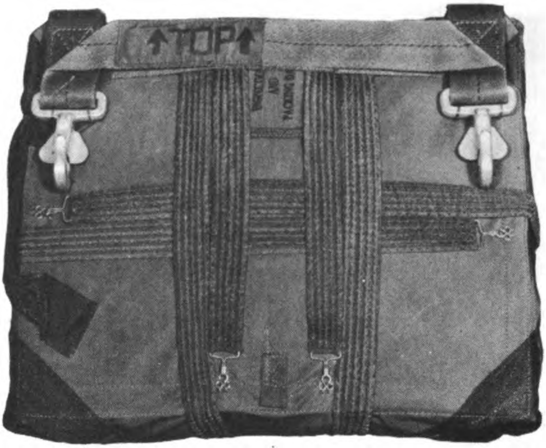


Figure 4–62.—Correct "hookup" pattern for pack opening bands.

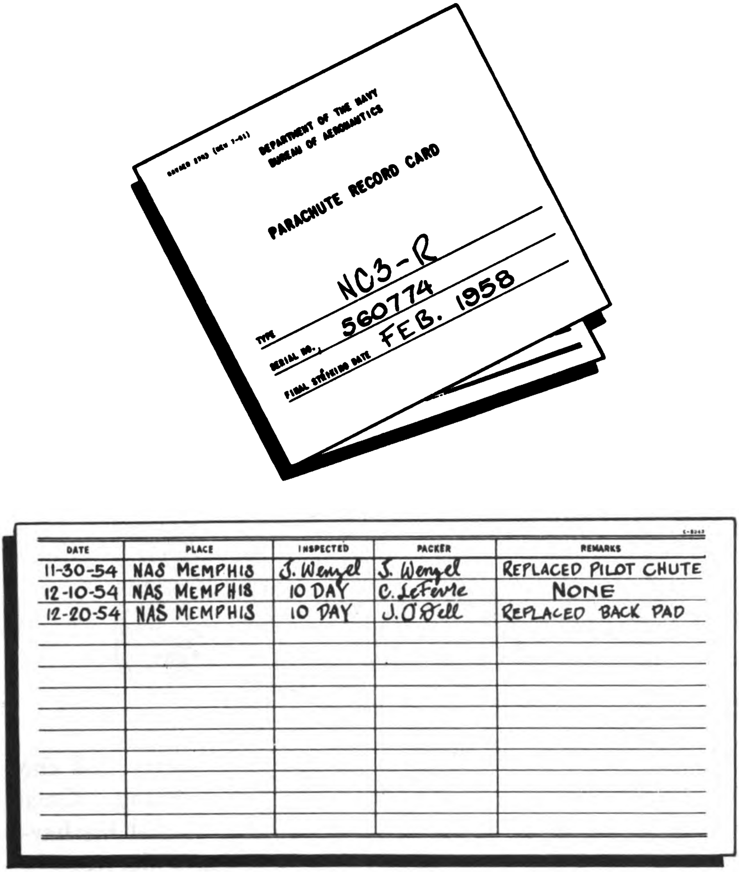
The compressed bulk of the canopy exerts enough pressure on the sides and ends of the pack to hold the pins in place. The addition of a safety tie tends to prevent, to a certain extent, a premature opening.

14. Hook up the opening bands. Make certain that the opening bands are free from twists and are properly fastened to the securing eyes of the pack. You won't have any difficulty in arranging the opening bands of this parachute since everything is right out in the open. There are no seat cushions or harness slings with which to cope. Figure 4–62 illustrates the correct passages for the opening bands.

The chest type parachute assembly is rigged so the container will break away with the lift web tackings. The bands pass UNDER the cross connector strap. Follow figure 4–62 carefully.

15. Make tests and adjustments.

16. Sign the Parachute Record Card. Do not print your name. The man inspecting and packing the parachute is responsible for signing the Parachute Record Card. His signature is a sign of approval and a guarantee that the parachute will WORK. A corresponding entry on the Parachute History Card is also made. (See fig. 4–63.)



DEPARTMENT OF THE NAVY
BUREAU OF AERONAUTICS

PARACHUTE RECORD CARD

TYPE NC3-R
SERIAL NO. 560774
FINAL SERVICING DATE FEB. 1958

DATE	PLACE	INSPECTED	PACKER	REMARKS
11-30-54	NAS MEMPHIS	J. Wenzel	J. Wenzel	REPLACED PILOT CHUTE
12-10-54	NAS MEMPHIS	10 DAY	C. LeFevre	NONE
12-20-54	NAS MEMPHIS	10 DAY	J. O'Dell	REPLACED BACK PAD

Figure 4–63.—Typical Parachute Record Card entries.

Fold the card and insert in the pocket provided on the pack. Check the pocket on the cross connector strap for an Emergency Signal Code. This form illustrates certain signals to be observed in aiding the individual's rescue.

Quick fit harness adjustment.—The quick fit chest type parachute harness is designed to be adjusted by the individual wearing the parachute before the aircraft becomes airborne. Everyone concerned should know how to wear, adjust, and in this case, hook up his chest type parachute. It is the pilot's responsibility to make certain that all hands flying in his aircraft are checked out in this respect. Since this parachute is designed to be adjusted on the spot by the individual, no tackings need be made by the Parachute Rigger. However, if certain individuals desire the chest strap hardware to be tacked in place on the respective chest strap, it is permissible to make the two tackings as follows:

1. Measure down 6 to 8 inches from the shoulder adapters.
2. Position hardware.
3. Tack in place, using 6-cord nylon thread. (See fig. 4-64.)

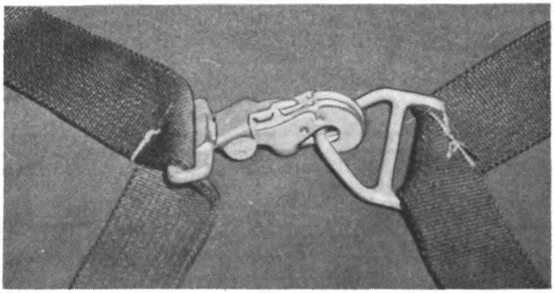


Figure 4-64.—Chest strap tacking.

Check out everyone in your squadron properly and the chances are that they will not want a tacked fitting. Once the individual has learned how to wear and adjust his harness, he may want to loosen this adjustment under certain conditions, perhaps move the chest hardware slightly up or down for comfort. Tacking the chest strap prevents any further movement of the hardware. Loosening the harness should be discouraged, as many people will forget to tighten it in an emergency.

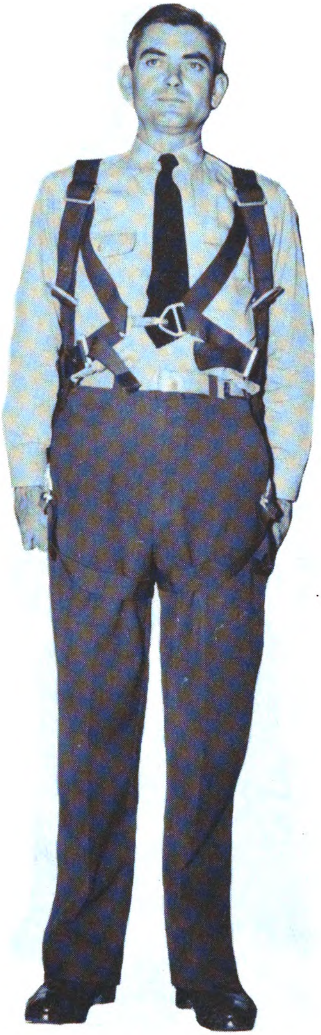


Figure 4–65.—Harness donned and hardware fastened.

Don the harness by slipping the arms between the chest and back straps. (See fig. 4–65.)

Pull both left and right leg strap ends downward diagonally to a snug fit. (See fig. 4–66.)

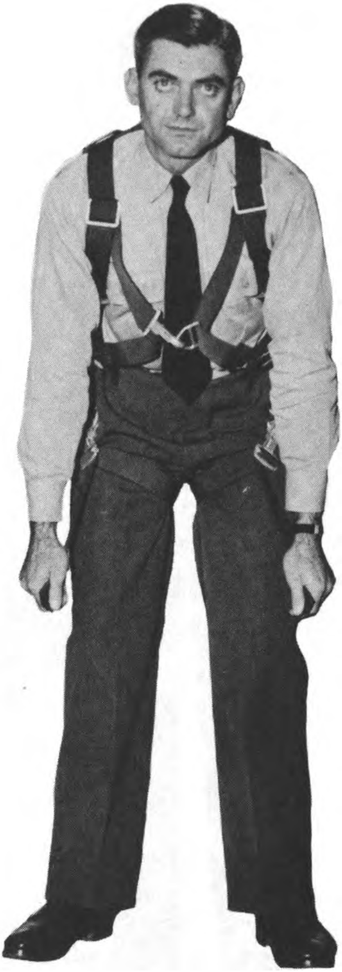


Figure 4–66.—Leg straps adjusted to a snug fit.

Pull upwards diagonally on both left and right chest strap ends until a snug fit is obtained. This operation removes all slack in the chest and back straps. The shoulder adapter should be located in the hollow just below the collar bone. If not so located, readjust until shoulder adapters are approximately located as shown in figure 4–67.

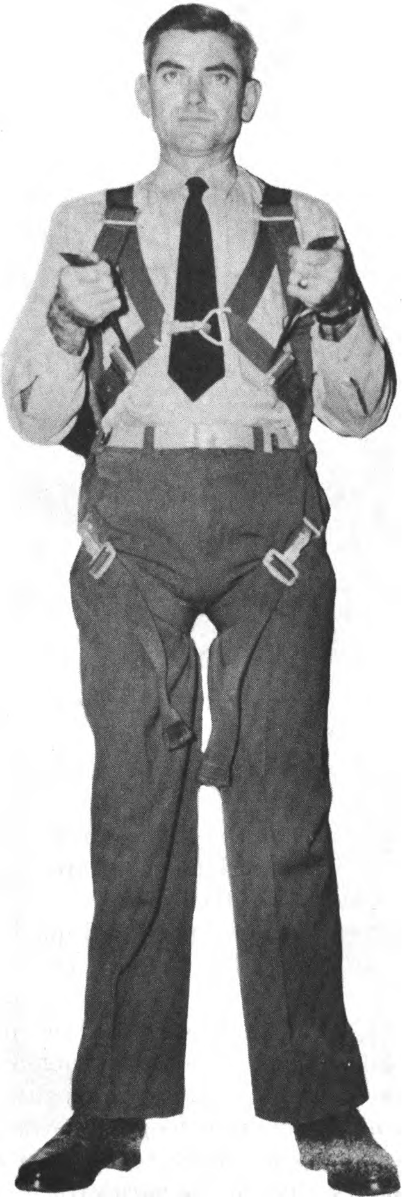


Figure 4–67.—Adjustment snug and completed.

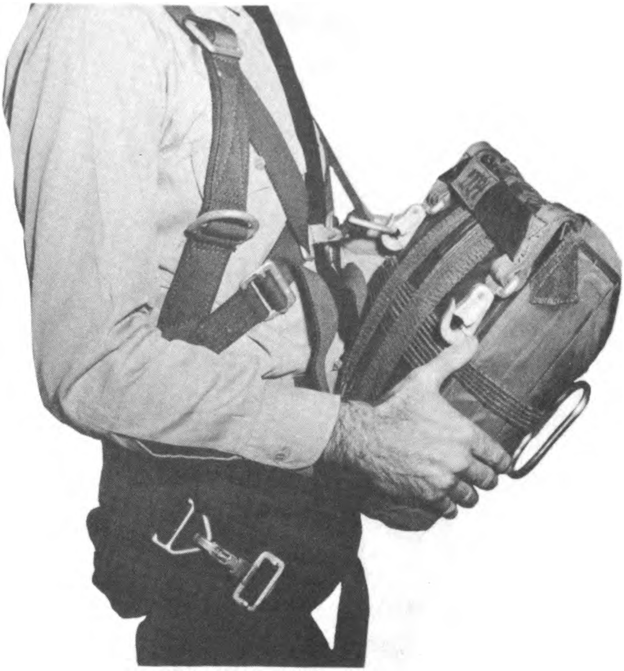


Figure 4–68.—Hooking up the pack.

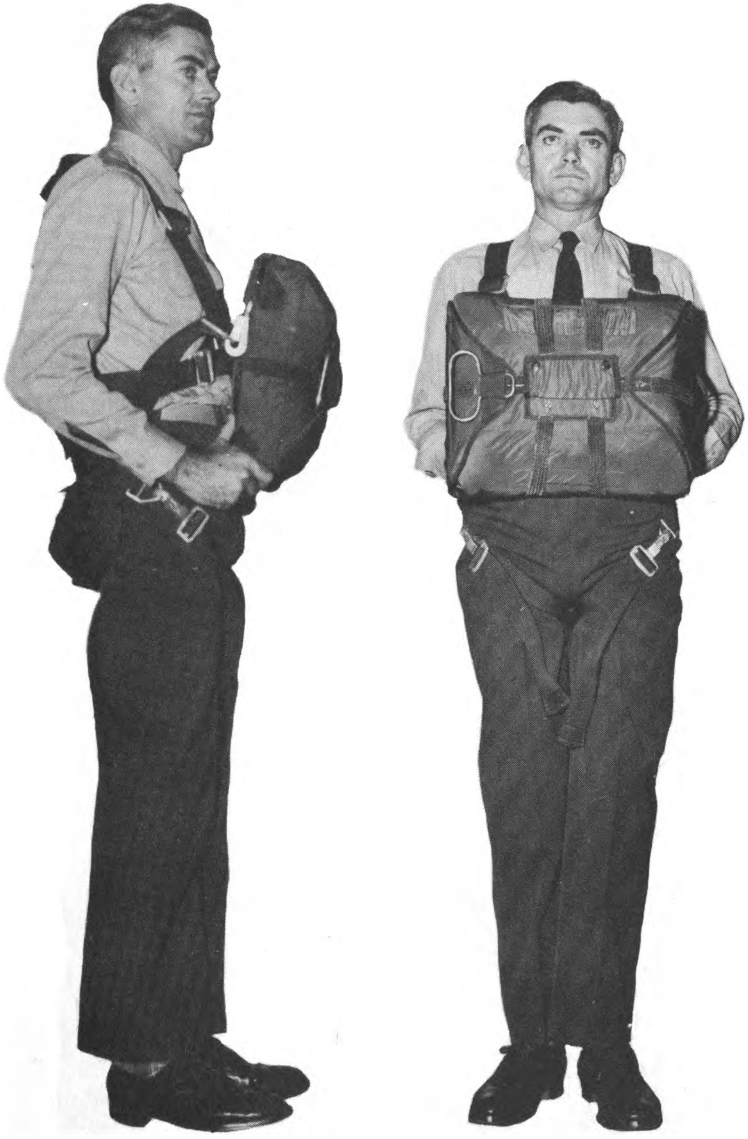
The loose webbing ends may be tucked under their respective straps.

Figure 4–68 illustrates the manner in which the quick connector snaps of the parachute pack are engaged with the quick connector D-rings of the harness.

The chest type parachute pack and quick fit harness assembly when fully donned and adjusted appears as shown in figure 4–69.

The quick adjustable hardware used on the chest and leg straps operates on the friction lock principle. When a pull away from the hardware is exerted, the sliding bar, around which the harness webbing is looped, moves in the direction of pull, thus locking the webbing between the sliding bar and the stationary piece of the hardware.

To loosen the harness, grasp the quick loosening tabs



(A) (B)

Figure 4-69.—Side view (A) and front view (B) of pack and harness.

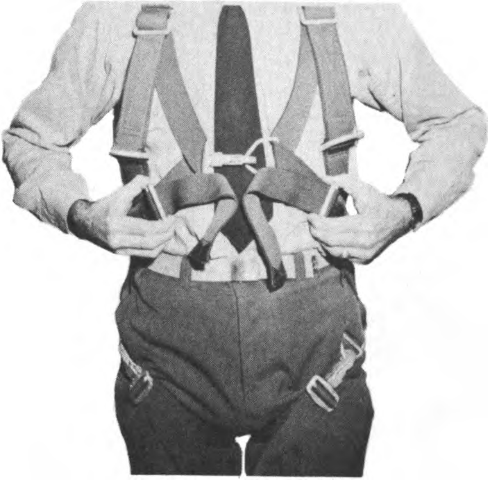


Figure 4–70.—Loosening the adjustment.

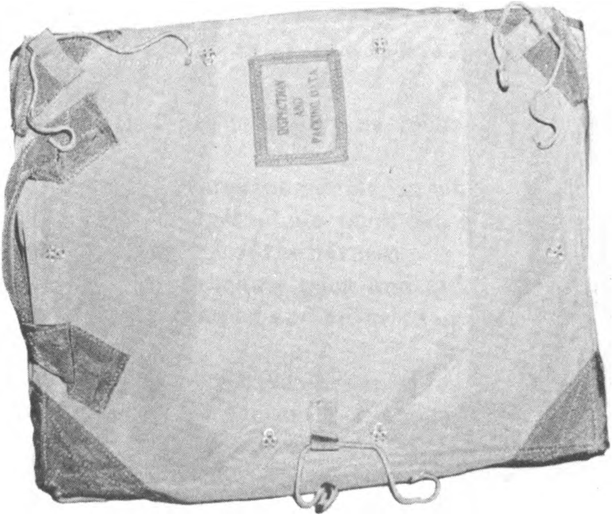


Figure 4–71.—Position of tape loops for pararaft kit attachment.

or V-rings and tilt the friction snaps at right angles to the webbing and pull. Harnesses equipped with ejector type hardware may be loosened as shown in figure 4–70. ***Caution:*** "Dumping" the snaps will completely disengage the security of the harness.

Rigging the pararaft kit.—The chest type parachute may be rigged with the pararaft kit at the discretion of the unit commander.

The rigging procedures follow:

1. Using a "box X" stitching pattern sew three 3½-inch lengths of ¾-inch nylon tape to the parachute pack and pararaft kit container at the points indicated in figure 4–71. Fold each piece of tape before sewing to form a ½-inch loop through which is passed a 10-inch length tie, which is cut from Type III suspension line.

When making tackings or sewings around the canopy and suspension lines remove the canopy and suspension lines from the pack prior to any sewing or tacking operation. If you

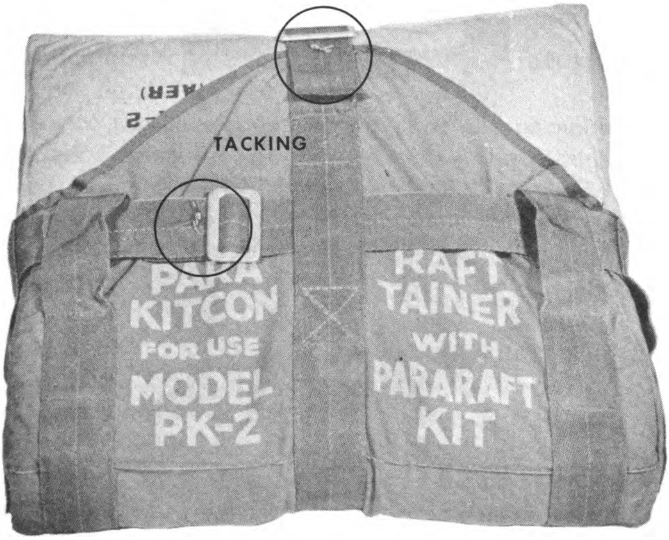


Figure 4–72.—Fit the pararaft kit container to the pararaft kit.

do not follow this rule, there is the danger of inadvertently sewing the canopy and lines to the pack.

2. Insert the pararaft kit into its container and engage the releasing mechanism. Make adjustments with the aid of the two adapters, making certain that the pararaft fits snugly in its container but not so tight as to make the removal of the pararaft kit difficult in an emergency. Tack each adjustment with one turn of 6-cord nylon thread, single, immediately behind each adapter. (See fig. 4–72.)

3. Before packing the parachute, tack the lift web assembly—one turn each through edges of lift webs and around

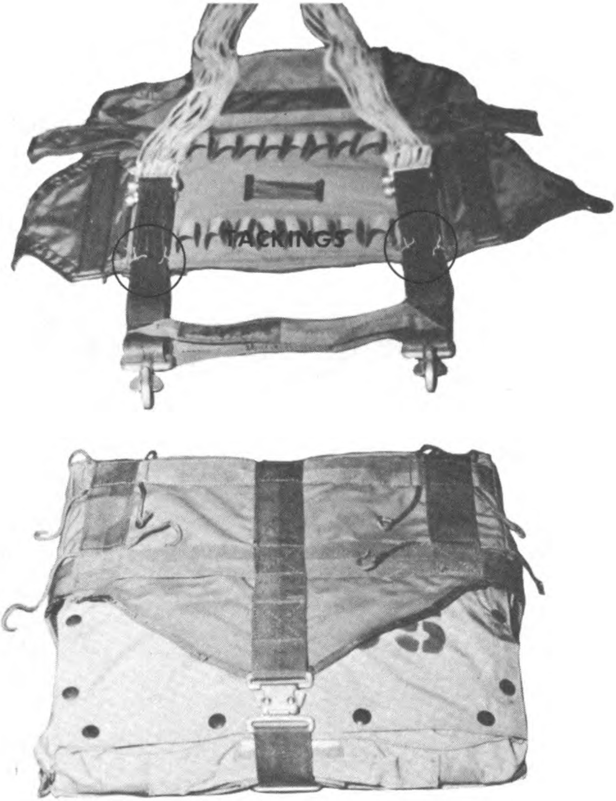


Figure 4–73.—Positioning and tacking procedure for chest type lift web assembly when the parachute is rigged with a pararaft kit.

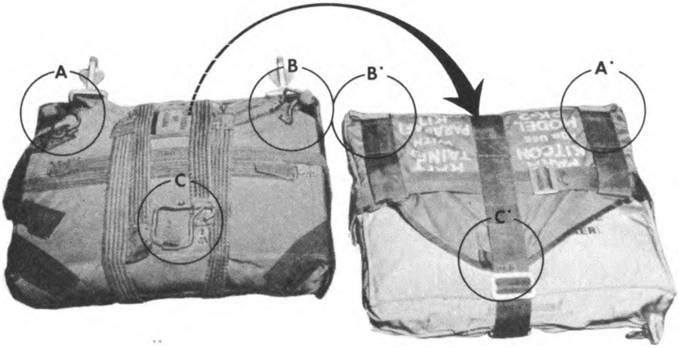


Figure 4–74.—Corresponding securing points between chest type pack and pararaft kit container.

the pack frame. Use size "E" nylon thread. Tie off with a surgeon's knot. Note that the lift web assembly has been drawn out of the pack to its limit where the chafing webbing has been doubled back on the risers. (See fig. 4–73.)

4. Pack the parachute, following the appropriate steps established for packing the chest type parachute without raft attachment.

5. Match up the packed parachute and pararaft kit assembly. (See fig. 4–74.)

6. Secure the corresponding loops of the parachute and pararaft kit assemblies (fig. 4–75), using the 10-inch nylon tie cords tightly square-knotted. Since the knotted nylon cords may slip and loosen, tack several passes of 3- or 6-cord nylon thread through the knots for security.

7. Secure the quick connector snaps to the pararaft kit container. (See fig. 4–76.)

The quick connector snaps are not as rigidly secured to the pararaft kit container as they were to the pack. However, they are tied as tightly as possible. A considerable amount of slack still exists in the pararaft kit container, as this assembly does not contain a frame for rigidity purposes as does the parachute pack. Extra care must be taken to properly engage the chest type parachute with the corresponding harness hardware when it is rigged with a pararaft

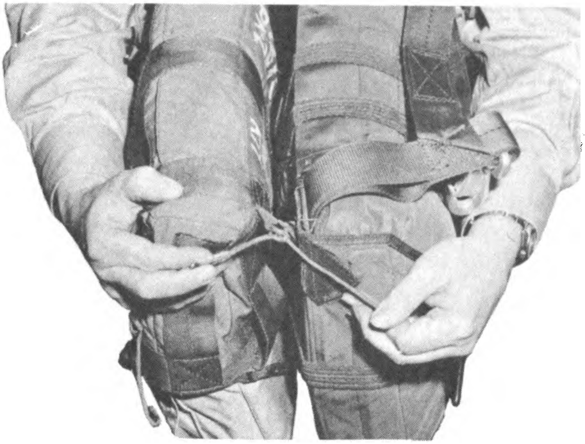


Figure 4–75.—Tie the pararaft kit container to the parachute pack.

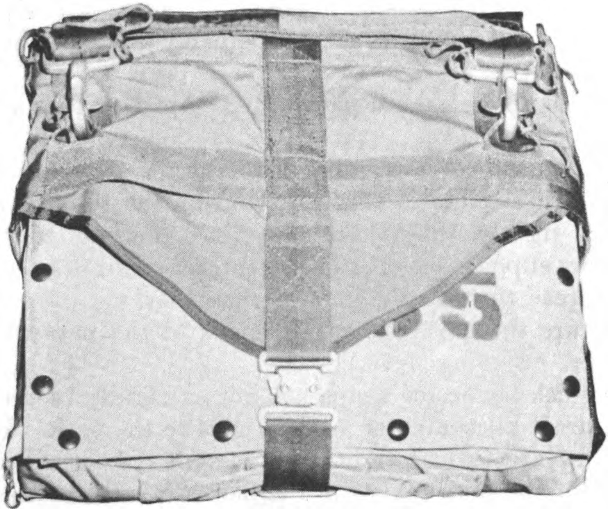


Figure 4–76.—Quick connector snaps secured to the pararaft kit container.

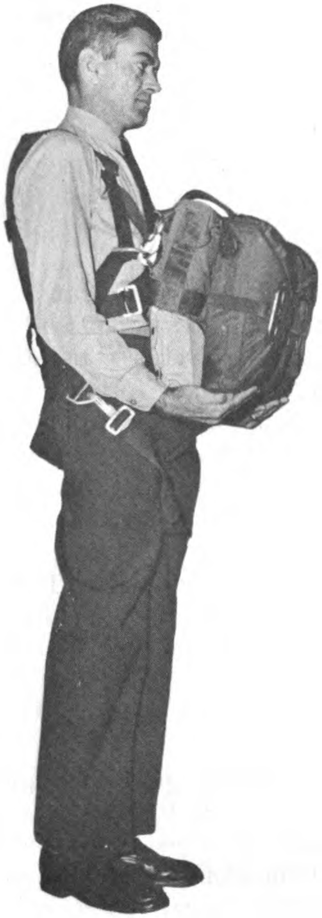


Figure 4–77.—Chest type parachute rigged with a pararaft kit.

kit. This knowledge must be imparted to those who may use one of these rigs. The complete assembly, properly worn, is shown in figure 4–77.

PACKING AND RIGGING WITHOUT THE PARARAFT.—The seat type parachute is packed in about the same manner as the chest type, except the pack must be flatter. Certain minor variations in the packing often result in packs of varying thicknesses and contour which affect seat stability and pack height. Seat stability and pack height greatly affect comfort and the physical relation of the pilot to the aircraft. It has become increasingly important to effect uniformity and space economy in packing to provide parachutes of minimum thickness and relatively rectangular contour. The flat packing method insures a uniform pack thickness.

In our study of packing and rigging the seat type parachute, the packing steps involving identical procedures with the chest type parachute will not be repeated.

The rigging and flat packing steps are:

1. Brush off the table.

2. Lay out tools and equipment. In this case the tacking thread used to tack the lift webs in the pack will be lighter than the tacking cord used on the chest type parachute. Double nylon thread size "E," tensile strength 8.50 pounds, is to be used. The use of anything heavier is contrary to instructions.

3. Lay out the seat type parachute, pulling the peak, and unchaining the suspension lines.

The pack, harness, ripcord housing, ripcord, ripcord pocket, seat cushion, and back pad are shown in figure 4–78, with all parts in their relative positions.

In step 3 the parachute was disassembled. The following procedure for assembling and rigging the parachute, including the inspection, is recommended. Figure 4–79 is a rigging diagram for the seat type parachute, model NS3–R.

4. Clear the table, except for the canopy. Hook up the canopy, manufacturer's nameplate UP, and check the suspension lines for entanglement. Remove fouls at the links. Inspect the canopy.

After you have finished inspecting the canopy and the

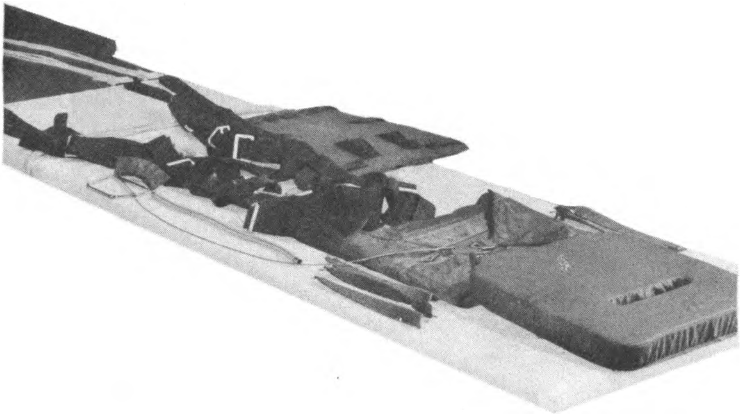


Figure 4–78.—Seat type parachute completely disassembled.

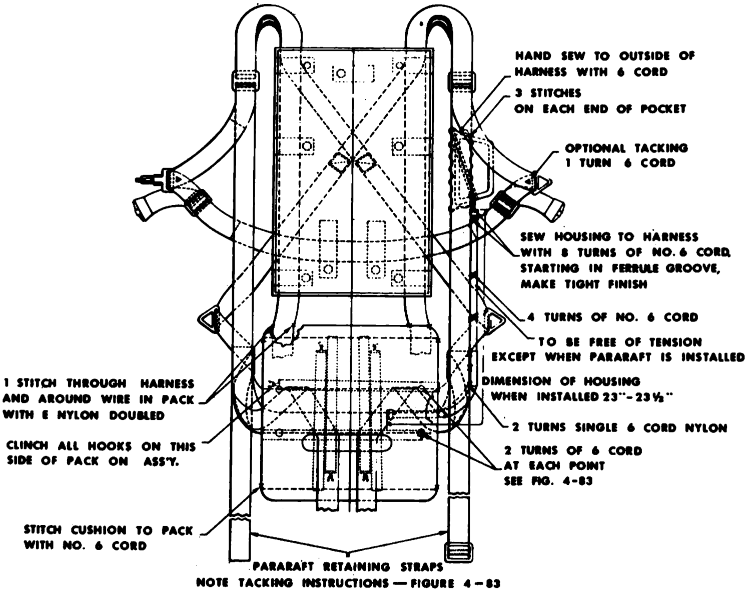

HAND SEW TO OUTSIDE OF HARNESS WITH 6 CORD
3 STITCHES ON EACH END OF POCKET
OPTIONAL TACKING 1 TURN 6 CORD
SEW HOUSING TO HARNESS WITH 8 TURNS OF NO. 6 CORD, STARTING IN FERRULE GROOVE, MAKE TIGHT FINISH
4 TURNS OF NO. 6 CORD
TO BE FREE OF TENSION EXCEPT WHEN PARARAFT IS INSTALLED
DIMENSION OF HOUSING WHEN INSTALLED 23"-23½"
2 TURNS SINGLE 6 CORD NYLON
2 TURNS OF 6 CORD AT EACH POINT SEE FIG. 4-83
1 STITCH THROUGH HARNESS AND AROUND WIRE IN PACK WITH E NYLON DOUBLED
CLINCH ALL HOOKS ON THIS SIDE OF PACK ON ASS'Y.
STITCH CUSHION TO PACK WITH NO. 6 CORD
PARARAFT RETAINING STRAPS
NOTE TACKING INSTRUCTIONS — FIGURE 4-83

Figure 4–79.—Rigging diagram for the NS3–R parachute.

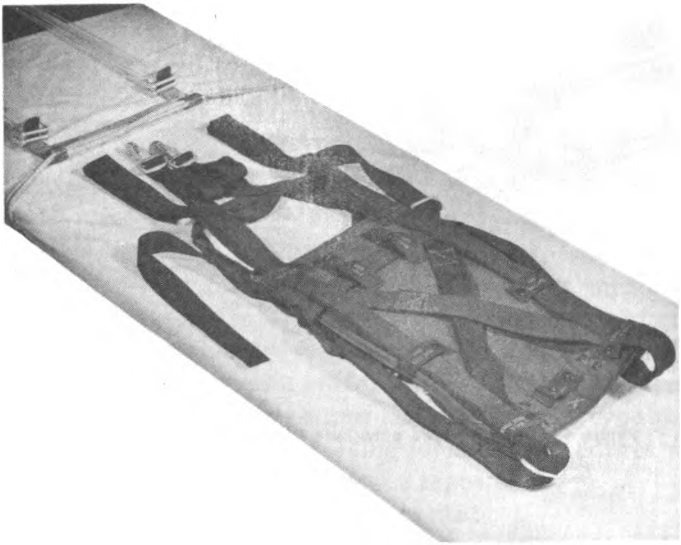


Figure 4–80.—Harness and canopy laid out in proper position for assembly.

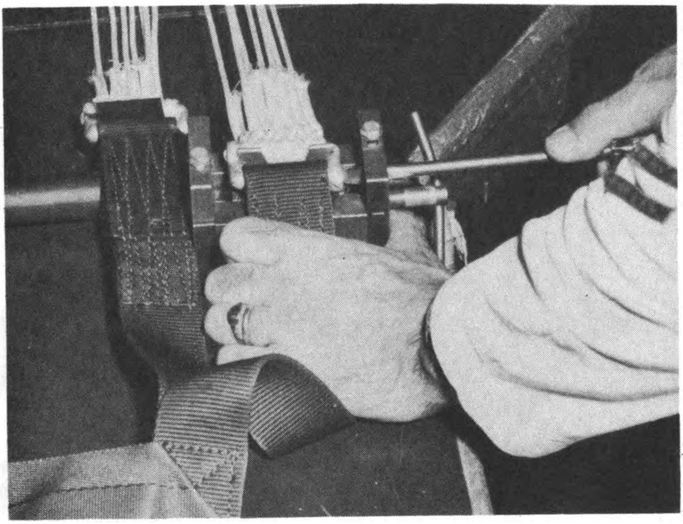
rotation of the suspension lines, release the tension on the parachute. Do not unhook the links. Check the harness for twists. Inspect the assembly carefully; now is the time to discover discrepancies.

Attach the back pad and lay out the harness in the proper position to receive the canopy. (See fig. 4–80.)

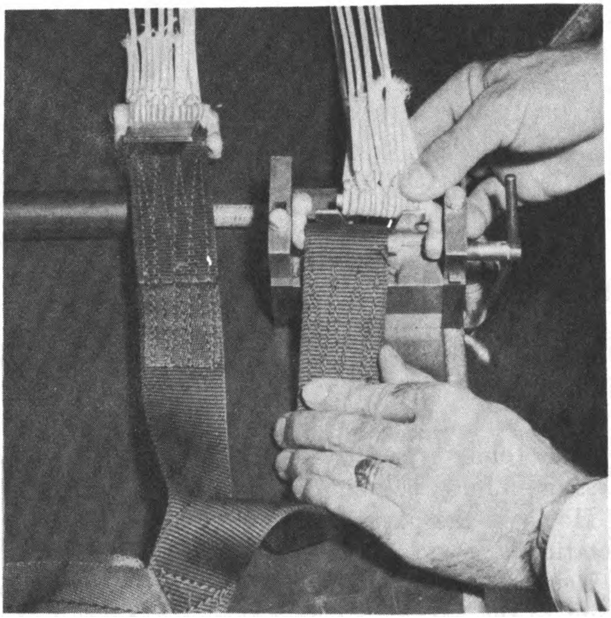
Using the torque-T screwdriver, or any torque instrument adaptable to the connector link screws, loosen each screw until all eight screws can be removed by the fingers. It is very important to hold the link and screwdriver squarely together during this operation to prevent damage to the grooves in the screwheads. The selection of the proper size screwdriver blade for the groove in the screwhead is vital for this operation.

Some Riggers prefer to use a link separator throughout the entire operation of loosening and tightening the connector link screws. The link separator and its principle of operation is illustrated in figure 4–81.

Great care must be exercised in transferring each link from



(A)



(B)

Figure 4—81.—The link separator and its use. (A) Removing screws; (B) separating the link halves.

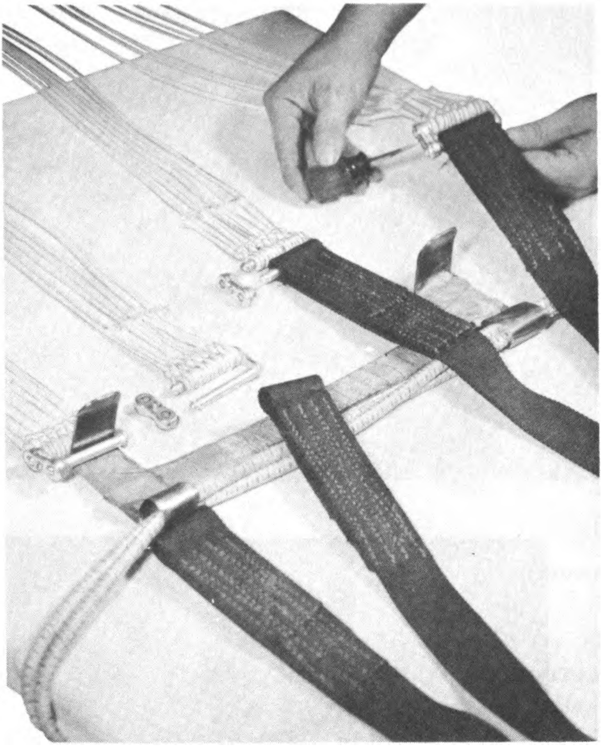


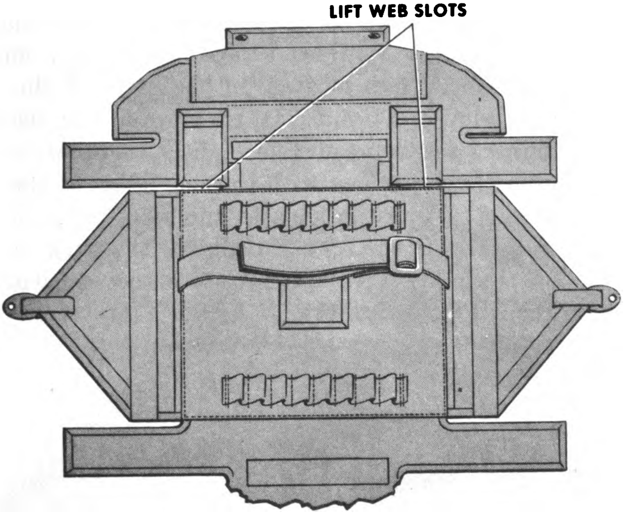
Figure 4–82.—Attachment steps in connecting the links to the harness.

the retaining hooks of the table to the harness. There are numerous ways of doing this. The attachment steps are illustrated in figure 4–82, using the latest type removable links.

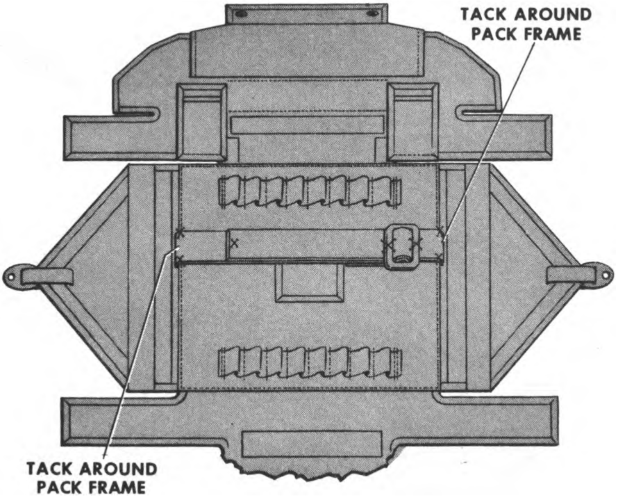
After each link screw has been tightened to a torque of 25 pounds (older type links shown in fig. 4–81), check the harness again for twists and the lay of the lift webs.

Hook up the parachute and recheck the suspension line rotation.

Release the parachute and prepare the pack for attachment to the harness. Check the pack for compliance with the latest modifications. Always inspect every new piece of equipment before assembling to the parachute.



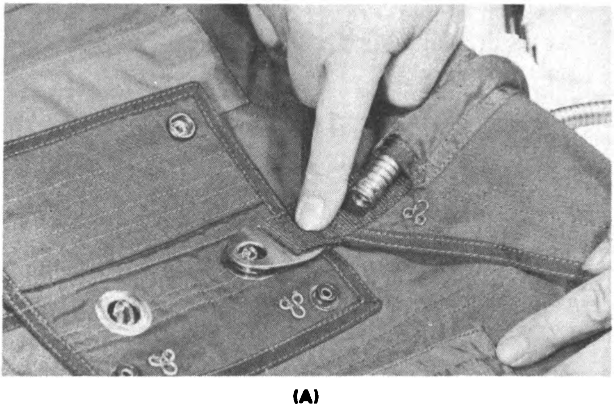
(A)



(B)

Figure 4–83.—Method of securing harness to pack. (A) Retainers entered into pack; (B) retainers drawn up tightly and secured.

When the pararaft kit is not used in the parachute assembly, the pararaft retainer straps are pulled entirely through the 2-inch slots located on the ends of the pack. (See fig. 4–83, views (A) and (B), for rigging instructions.) As the retainers are being drawn tightly together, line up the centerline of the harness with the centerline of the pack. Guard against twisting the harness and retainers. The leg straps must be facing the forward edge of the pack in order for the lift web slots to be in the correct position for receiving the lift web assembly.


(A)

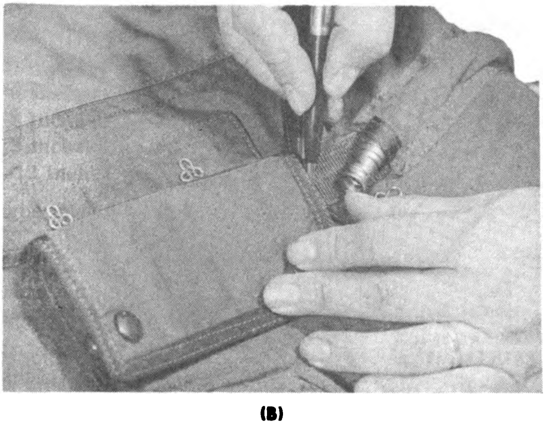

(B)

Figure 4–84.—Marking a reference point for the location of the ripcord housing. (A) End tab placed over cone; (B) flap in position.

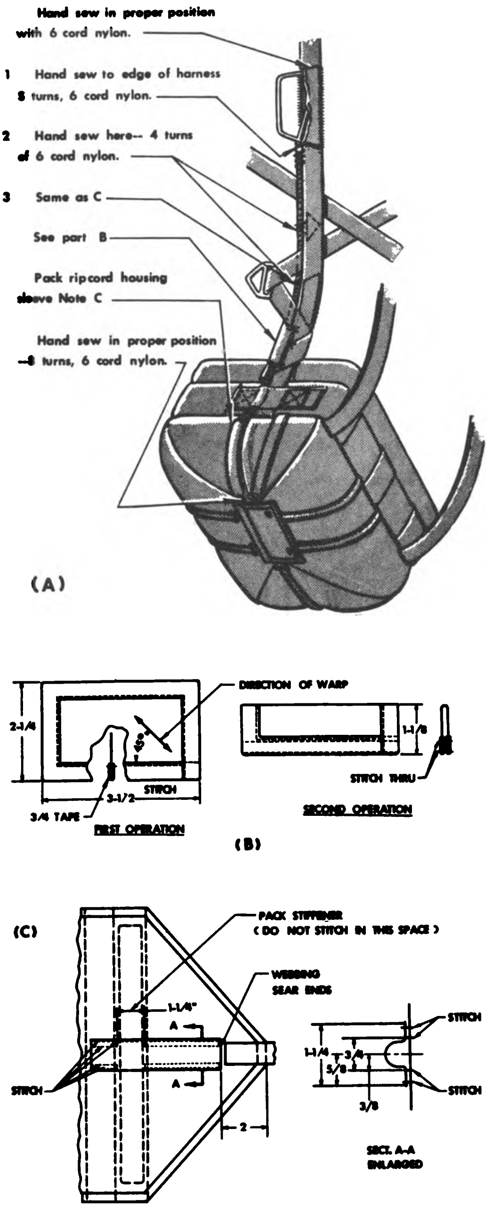


Figure 4–85.—Attachment of ripcord housing to seat type pack.

Pass the extensible ripcord housing through the sleeve located on the ripcord end of the pack. Close the pack and fold the ripcord protector flap down over the locking cones. Mark a line on the end flap of the pack along the edge of the ripcord protector flap. (See fig. 4–84.)

Draw up the housing ferrule within $1/8$ inch of the reference line made on the end flap and hand sew housing. (See fig. 4–85.)

Take the free end of the housing and pass it through the sleeve on the main sling. (See fig. 4–86.) This will prevent unnecessary exposure of the ripcord housing and entanglement with cockpit projections.

The extensible housing and ripcord now being used on the seat type parachute has lessened the possibility of a premature opening. However, before tacking the housing and ripcord pocket to the harness, the best policy is to pack the parachute. Attach the pack opening bands to the anchoring eyes located on the underside of the pack.

Attach the seat cushion. Draw the leg straps through the slot provided in the front half of the cushion. Tack to pack. (See fig. 4–87.)

Check the lift webs for twists. Position the lift webs in the pack and tack as shown in figure 4–88, using a double length of size "E" nylon thread. Form a single loop of thread on each side of the webbings by passing the needle through both thicknesses of webbing, the container fabric, corner reinforcements, and around the pack frame. Tie off, using a surgeon's knot.

5. Hook up the parachute and make preparations for packing. The canopy has been inspected. Restraighten the skirt hem of the canopy. Figure 4–89 illustrates the proper method of laying out the parachute under tension for packing.

NOTE: Steps 3, 4, and 5 are very closely associated. There are times when certain conditions will dictate an overlapping of these step procedures. Sometimes it is justifiable to perform step 5 before starting step 4. A great deal depends

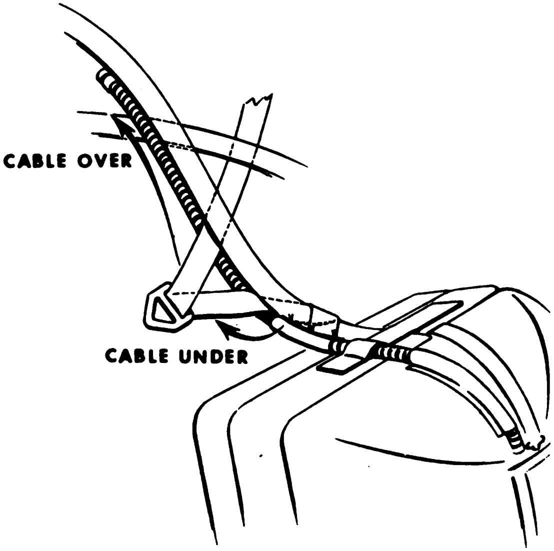
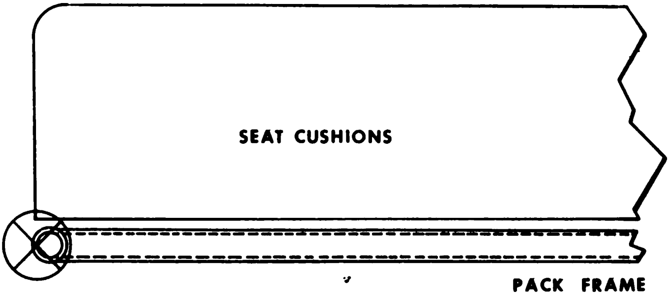


Figure 4—86.—Housing passage through harness sleeve.



2 TURNS 6 CORD DOUBLED AROUND
PACK FRAME ON 4 CORNERS AS INDICATED Ⓧ

Figure 4—87.—Seat cushion tacking to pack.

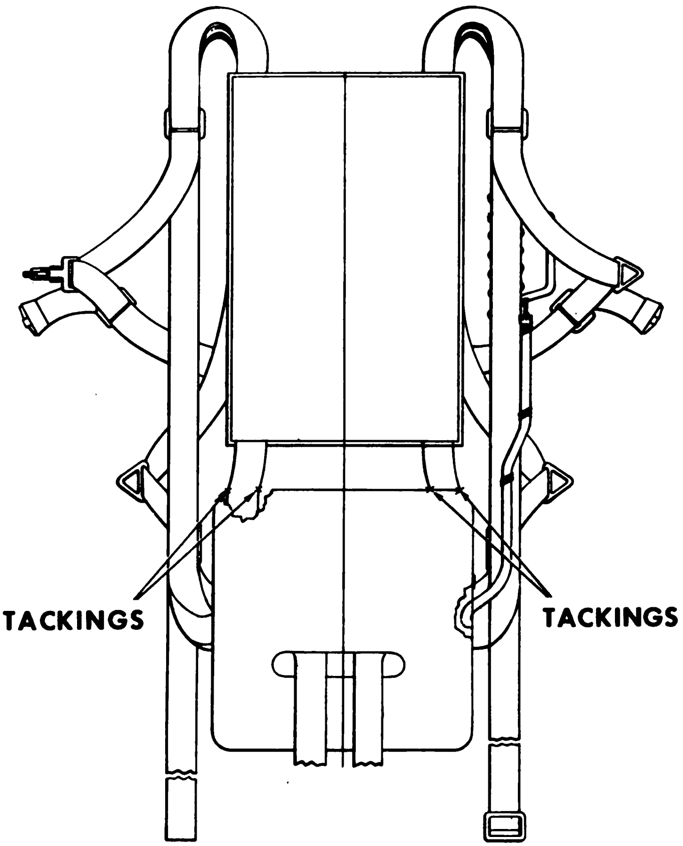


Figure 4–88.—Lift web tacking.

on the condition in which you receive the parachute. The parachute can be delivered to you for packing in a number of ways: packed, unpacked, unpacked and disassembled, and new from Supply in a metal container.

6. Whip and fold the canopy. All phases are the same as for the chest type parachute. The dimensional width of the last two folds has been increased. (See fig. 4–90.)

7. Unhook and prepare the pack to receive the suspension lines. (See fig. 4–91.) Sign the inside Parachute Record Card and insert it in the pocket.

8. Insert suspension lines in pack.

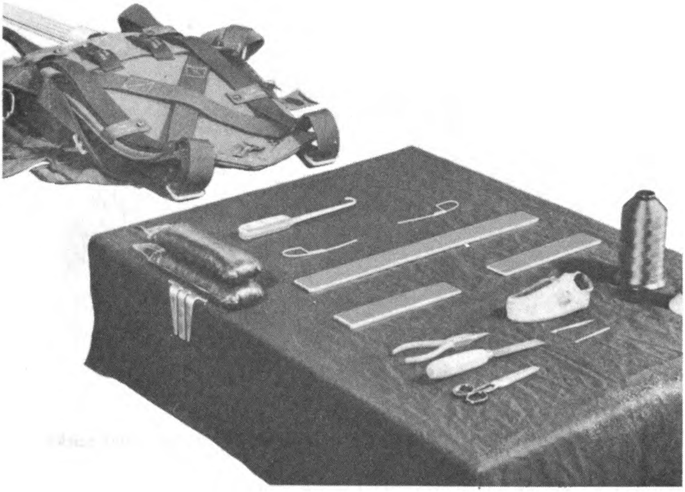


Figure 4–89.—Seat type parachute under tension.

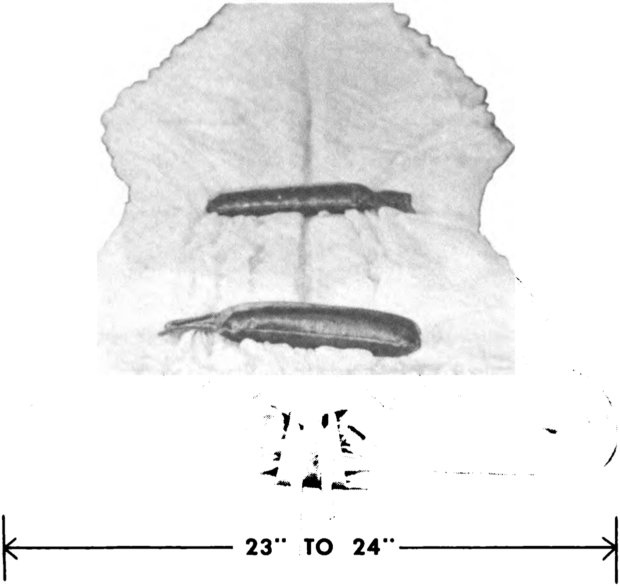


Figure 4–90.—Folded width, 23 to 24 inches.

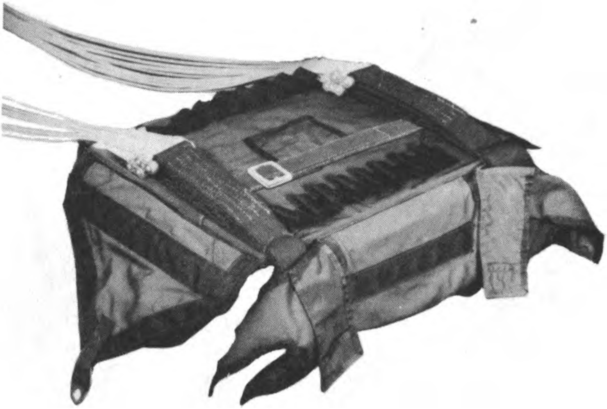


Figure 4–91.—Harness and pack sides folded and placed under pack

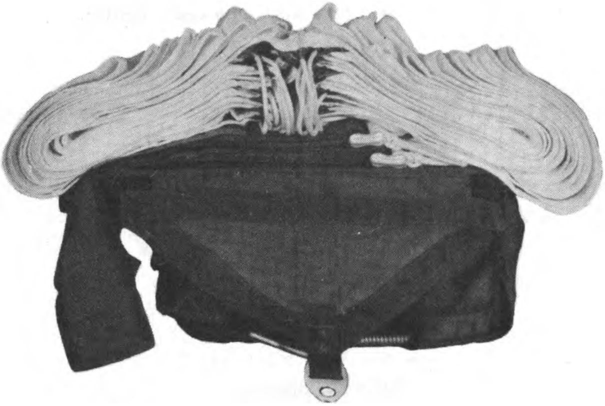


Figure 4–92.—Canopy in position on pack.

9. Place the canopy on the pack. (See fig. 4–92.) The skirt is brought up to the ripcord end and the canopy is permitted to drape over the sides of the pack for approximately 3 inches.

The short fold is placed conventionally behind the skirt hem but the opposite end is allowed to extend over the pack end 3 to 4 inches. (See fig. 4–93.)

Place the remaining folds of the canopy to extend beyond

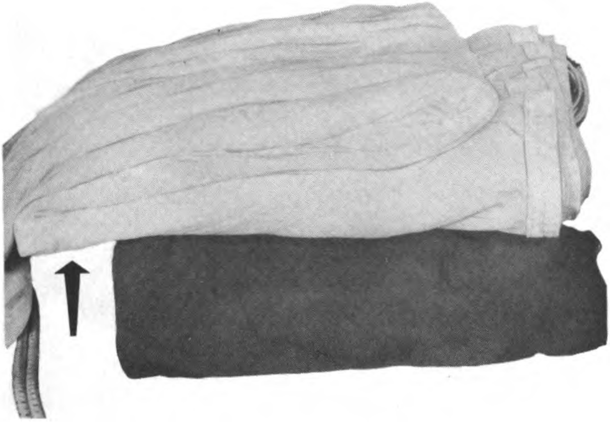


Figure 4–93.—Bottom rear fold extending beyond end of pack.

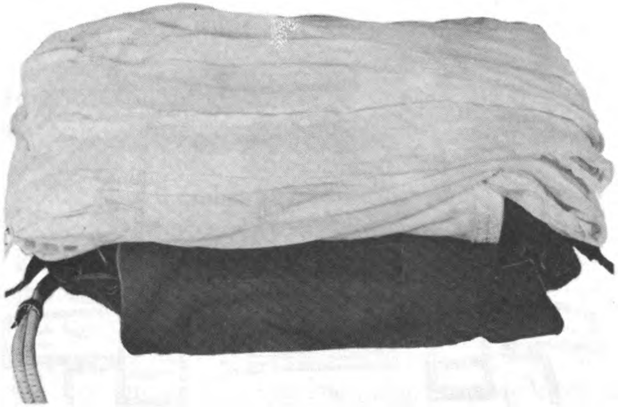


Figure 4–94.—The remaining folds placed on the pack.

all sides of the pack for a distance of approximately 3 or 4 inches. (See fig. 4–94.)

10. Position the pilot chute the same as for the chest type parachute.

11. Partially close the pack while maintaining the flat condition by forcing the canopy down and to the sides. (See fig. 4–95.)

12. Completely close the pack and insert the ripcord, smoothing out the added bulk of the canopy with the long

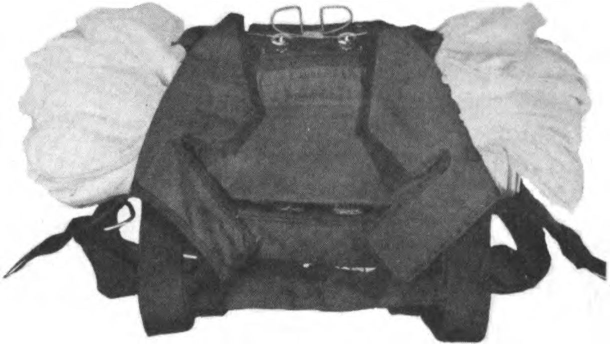
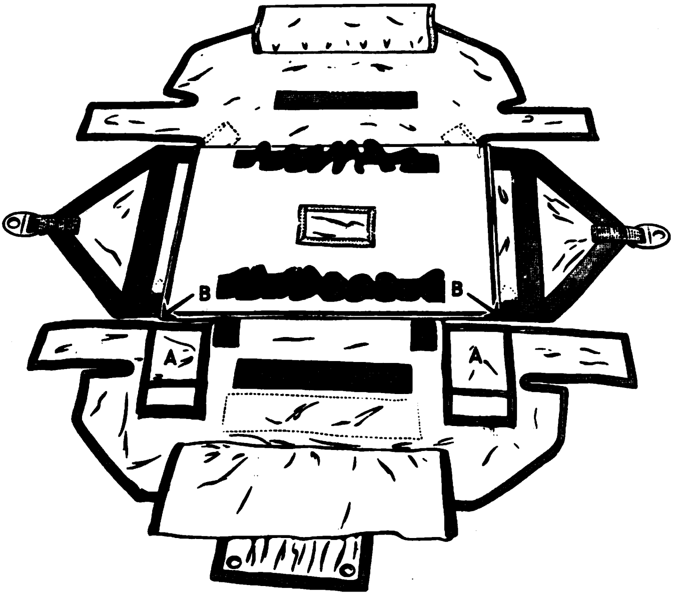


Figure 4–95.—Partially closed pack.



FLAPS 'A' HAVE BEEN SHIFTED TO APPROXIMATELY 3/8" BEYOND POINTS 'B' INDICATED BY ARROWS

Figure 4–96.—Repositioning lift web protector flaps to prevent flat packed canopy from showing.

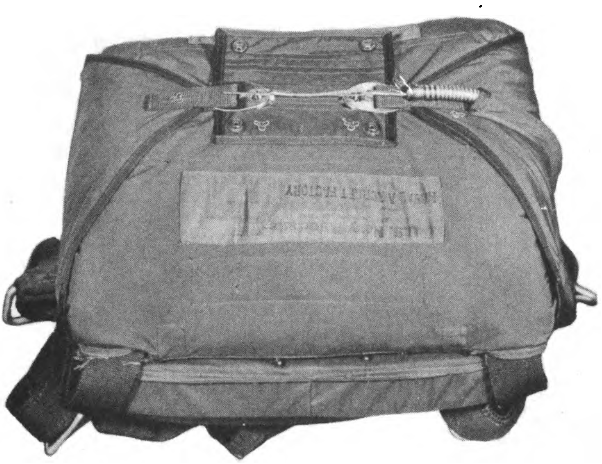


Figure 4–97.—Ripcord locking pins inserted.

bar. However, the fid may have to be used before the long bar is used to straighten the end flaps. Take care not to tear out the end flap pockets. The finished flat pack should not be any thicker than 6 inches at its thickest point.

Do not permit the canopy to protrude or show at the corners of the pack. It may be necessary, at the next scheduled packing, to move the lift web protector flaps toward the ends of the pack to accomplish this successfully. Prior to the flat packing method this was not necessary as the end flaps were not under the extreme tension they now are. Figure 4–96 illustrates the procedure to follow in repositioning the lift web protector flaps.

The pack is now completely closed and straightened. (See fig. 4–97.) The ripcord pins have been inserted in the locking cones. If the parachute were fully rigged (ripcord grip pocket in place), the ripcord handgrip would now be inserted in the handgrip pocket on the harness. Measure the thickness of the pack using any acceptable 6-inch gage.

13. Safety tie locking pins the same as for chest type parachute.

14. Hook opening bands to the side and end flaps, using

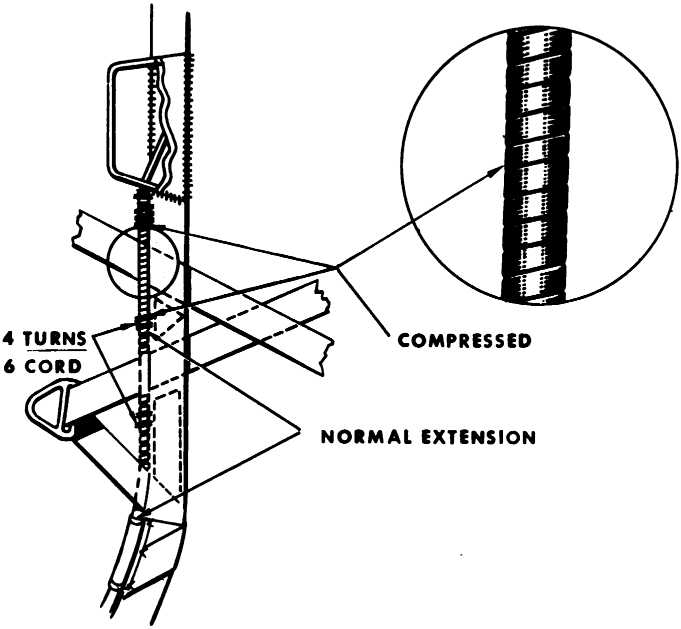


Figure 4–98.—Ripcord housing and handgrip pocket tackings for seat type parachute without pararaft.

the same procedure as for chest type parachutes, except that the opening bands are not as easily accessible. Since the opening bands all measure the same length and the pack is rectangular, you will encounter great difficulty in locating the end flap opening bands. In order to have made these bands more accessible and to speed up the packing process, it is good practice to engage their free ends in any projection that offers itself near the ends of the pack before beginning packing. This could be done when a fully rigged parachute was being prepared for dry locker. Since the parachute is being packed and rigged from a completely unrigged condition, you must consider the advisability of hooking all of the opening bands to their respective anchoring eyes at this time. The ripcord pocket and housing have yet to be hand sewed in place on the harness. At the completion of these sewings or tackings a test for premature opening is made. Do not

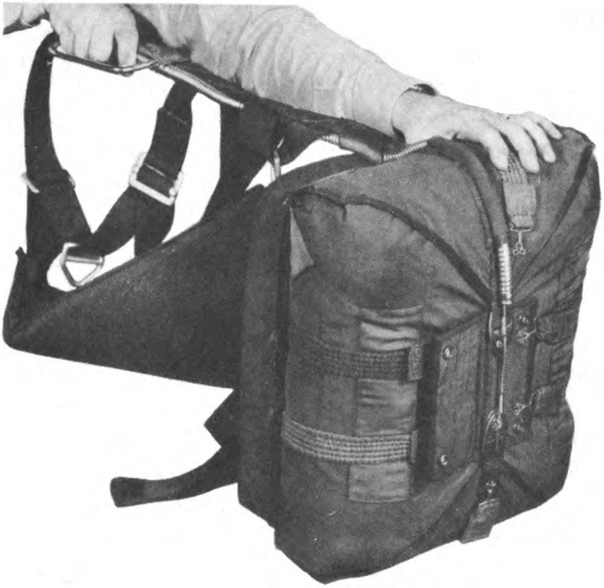


Figure 4–99.—Checking parachute for susceptibility of premature opening.

fasten the protector flap snaps until after the ripcord test.

15. Make tests and adjustments. This refers directly to the position of the handgrip pocket and the housing tackings. An improperly positioned ripcord assembly can cause a dangerous premature opening of the parachute. Every precaution must be taken to guard against this hazard. Figure 4–98 illustrates the remaining harness tackings to be made to the ripcord housing and pocket. In order to acquire the correct amount of elastic grip on the handle, hand sew the pocket to the harness with the handle inserted in the pocket. Always take the ripcord handgrip out of the pocket after this sewing is completed to check the grip of the pocket on the handgrip. This action also shows that the handgrip has not been sewed in the pocket.

Set the pack on end and grasp the harness through the handgrip and subject the harness to a vigorous steady pull of about 50 pounds (fig. 4–99). If the pocket is located too high on the harness or the housing has been tacked without leaving enough slack between the end flap tacking and first harness tacking, the ripcord pins can be drawn out of the tacking cones without pulling the ripcord. If the safety tie around the ripcord pin breaks on this test, a dangerous premature condition exists and must be corrected BEFORE the parachute can be signed for and ISSUED. An offcentered harness can be the cause of this condition. Too much slack in the retaining webbings will permit the pack to pull away from the harness, adding to the hazards of a premature opening. The extensible type ripcord has given the Rigger a greater margin for error in positioning the handgrip pocket. However, do not acquire the bad practice of failing to make the premature opening test regardless of the advantage of additional slack designed in the releasing device.

16. Sign the Parachute Record Card the same as for the chest type parachute, and make an entry on the corresponding Parachute History Card.

PACKING AND RIGGING WITH PARARAFT.—Attaching the pararaft kit to the seat type parachute is strictly a rigging problem. There is no change in the flat packing method, as this is the standard method of packing all seat type parachutes. Any seat type parachute shall be considered unacceptable for issue if it fails to pass the pack thickness gage check. This is especially important when it is rigged with the pararaft kit.

The pararaft kit is attached to the parachute by first unrigging the raft retaining straps, engaging them with the pararaft kit container keepers, and repassing the retainer straps back through the slots of the pack. A number of other important steps are involved in this process. The changeover to the pararaft kit is a major rigging job involving the disassembly of many appendages. Figure 4–100 illustrates the pararaft kit container and the PK–2 pararaft. The packing and testing procedures used on this pararaft kit and raft will be treated in volume 2 of this series.

The rigging procedures for the pararaft kit are as follows:

1. Place the pararaft kit in the pararaft kit container and fasten the release mechanism.

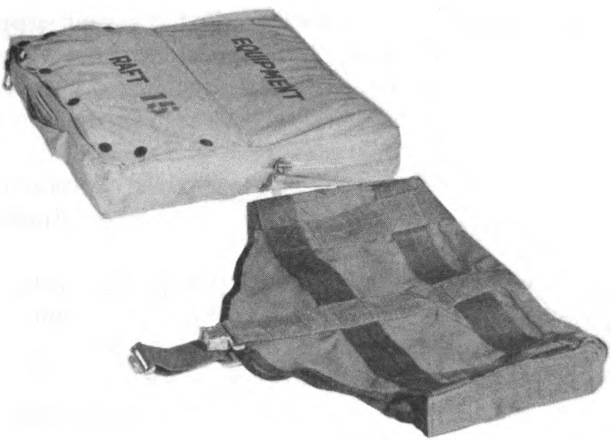


Figure 4–100.—Model PK–2 pararaft kit and kit container.

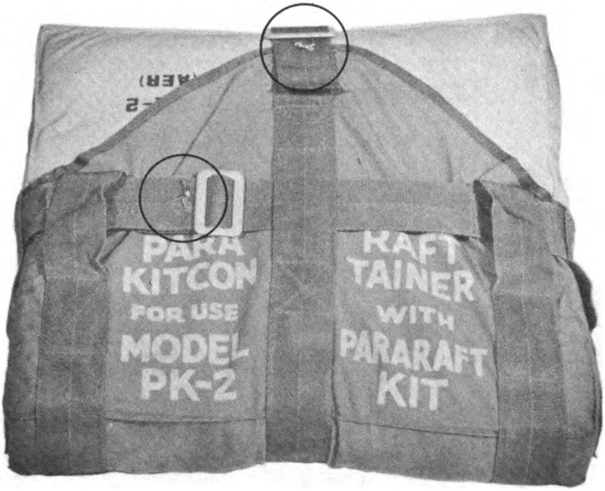


Figure 4–101.—Fit the kit container to the pararaft kit.

2. With the aid of the two adapters, shown in figure 4–101, make certain that the pararaft kit fits snugly in its container and yet is not so tight as to make removal of the pararaft kit difficult in an emergency. Tack each adjustment with

two turns of 6-cord nylon thread, single, to prevent slippage. Position these tackings through the free ends of the webbings and close to each adapter. Remember to tie off with a surgeon's knot and a square knot, and sear each cord end. This prevents unraveling.

3. If the parachute has not been prepared to receive the pararaft kit, the following procedures must be followed to make it ready:

Release the parachute and stow the canopy and suspension lines in a chafing bag, or simply set aside on the table. Cut the lift web tackings and remove the lift webs from the pack.

Remove the ripcord and the ripcord housing from the harness. The housing need not be removed from the end flap of the pack.

Remove the seat cushion.

Cut the securing tackings holding the retaining straps. Slip the retainer straps out of the pack slots completely dis-

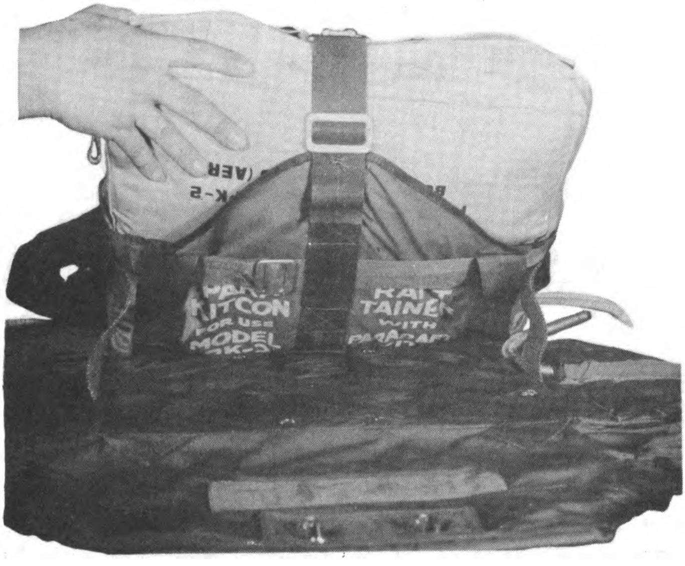


Figure 4–102.—Passage of the pararaft retainer straps through the pack slots before engaging the adapter.

engaging the pack from the harness. Cut the remaining tackings holding the lift webs in the pack. The parachute is now ready to be rigged with the pararaft kit.

4. Position the harness and pack in the correct attitude. Run the pararaft retaining straps through the side web loops (or keepers) of the pararaft kit container and through the pack slots as shown in figure 4–102.

Pass the free end of the webbing through the adapter, which has been passed through the webbing keeper in the pararaft kit container and the pack slot. (See fig. 4–103.)

Draw the two containers together snugly, removing all excess slack in the retaining straps. Tack this adjustment as shown in figure 4–104. Use two turns of 6-cord nylon thread as indicated. These operations are not performed while the pararaft kit is in the pararaft container. (See fig. 4–104.)

The opening bands should be attached at this point, as the next step will involve tacking the pararaft kit container close to the pack. Pass the leg straps through the keepers in the top of the pararaft kit container and reinsert the pararaft kit.

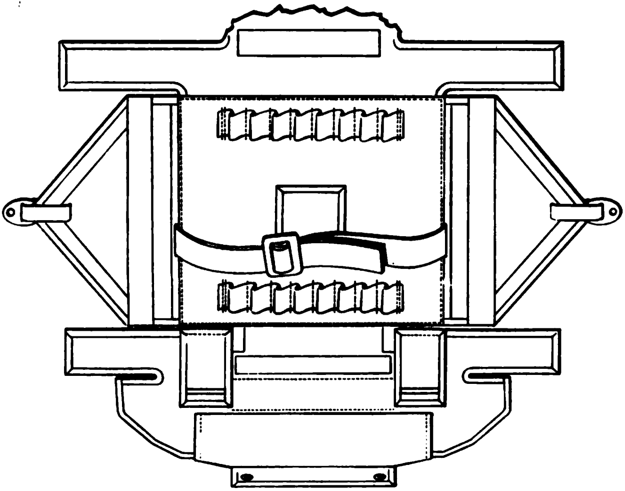


Figure 4–103.—Passage of the pararaft retainer straps after engaging the adapter.

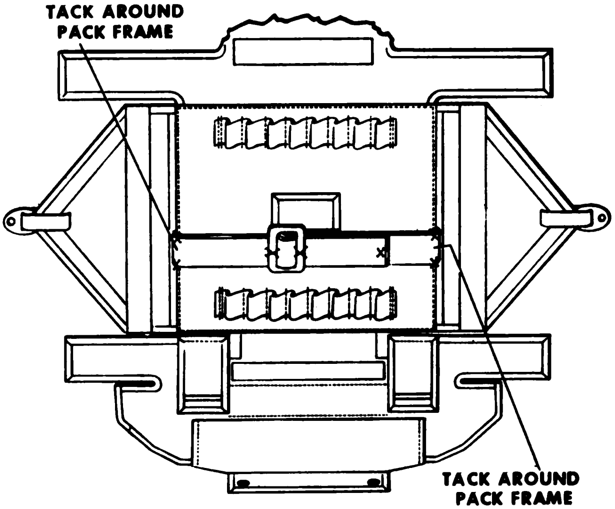


Figure 4–104.—Last adjustments tacked in place on the pararaft kit container retaining straps.

5. Lay the pararaft kit and container flat on the pack. Line up the rear edge of the pararaft kit container along the rear edge of the pack. When the pararaft kit protrudes over the front edge of the pack (by reason of size), compensate for this condition by shifting it slightly beyond the rear edge of the parachute pack. An extreme condition will require repacking of the pararaft kit. Straighten out any wrinkles or doubling under of the material of the container. Recheck the alignment of the container and pack. Make a visible mark with a light-colored crayon pencil at each tacking point on the parachute pack. After checking the relative sizes of the pararaft kit and parachute pack, an experienced Parachute Rigger may omit marking the tacking points. (See fig. 4–105.)

6. Remove the pararaft kit from the container to allow greater ease in performing the tackings and to prevent piercing the pararaft kit with the tacking needle. Tack the sides of the kit container to the parachute pack (fig. 4–106), using one turn of double 3- or 6-cord nylon thread. Be sure

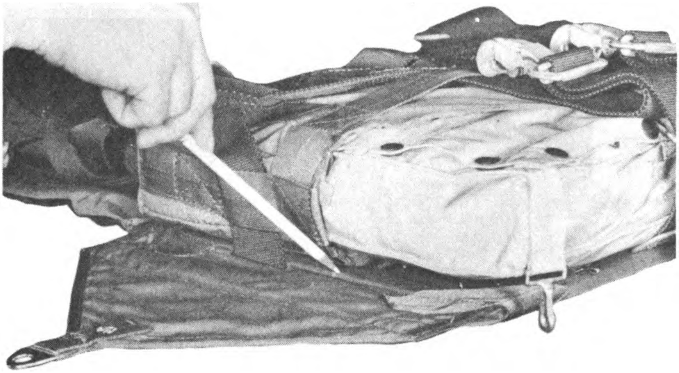


Figure 4–105.—Reference point for forward side tackings. The same reference mark is made on the opposite side.

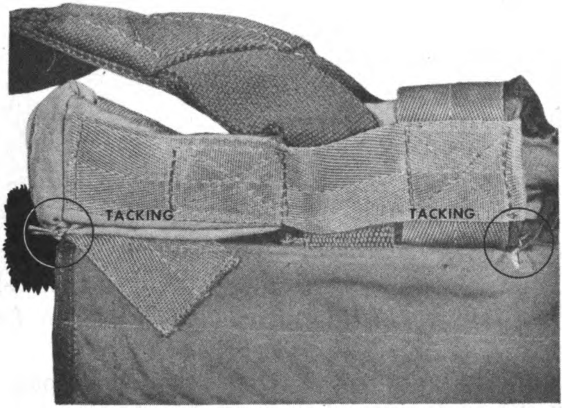


Figure 4–106.—Four tacking points; two as indicated and two on the opposite end of the pack.

that the tackings pass around the wire frame of the parachute pack.

7. Tack the front of the pararaft kit container to the parachute pack (fig. 4–107), using one turn of double 3- or 6-cord nylon thread. Two turns of cord (single) may be substituted for one turn (double), if one turn fails to hold properly.

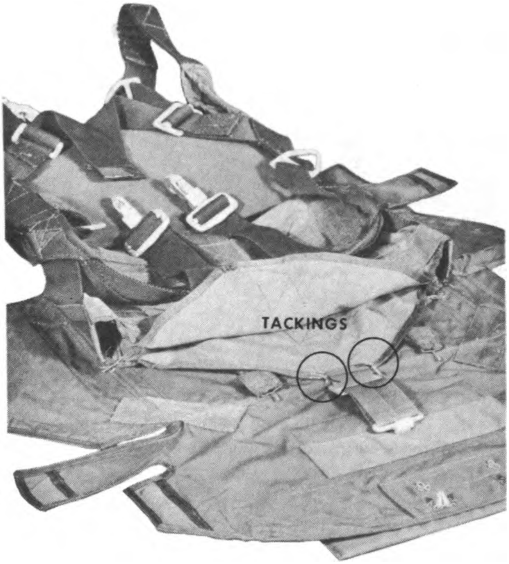


Figure 4–107.—Note that the tackings do not pass through webbing.

Pass tackings around the pack frame, maintaining a neat tacking pattern.

Reinsert the PK–2 into its container and fasten the releasing device. CENTER the HARNESS and tack with one turn of 6-cord nylon thread, doubled, to PREVENT SLIPPAGE. (See fig. 4–108.) Before making the tacking disengage the releasing device and lift the top of the PK–2 container away from the raft case.

8. Place a seat cushion over the main sling and pass the leg straps up through the slot provided in the cushion. Tack the seat cushion in position. Make a reference mark on both sides of the forward side tacking points. Remove the PK–2 and make four tackings (fig. 4–109), using one turn doubled 3- or 6-cord nylon thread.

9. Reinsert the pararaft kit. Do not fasten the releasing device. Make the last two forward tackings (fig. 4–110), using one turn doubled 3- or 6-cord nylon thread.

10. Refasten the releasing device and retack the lift webs.

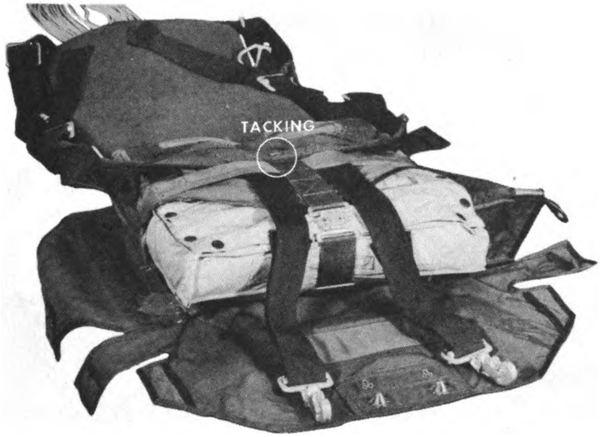


Figure 4–108.—Leg straps passed and centerline of main sling tacked to pararaft kit container. Releasing device fastened.

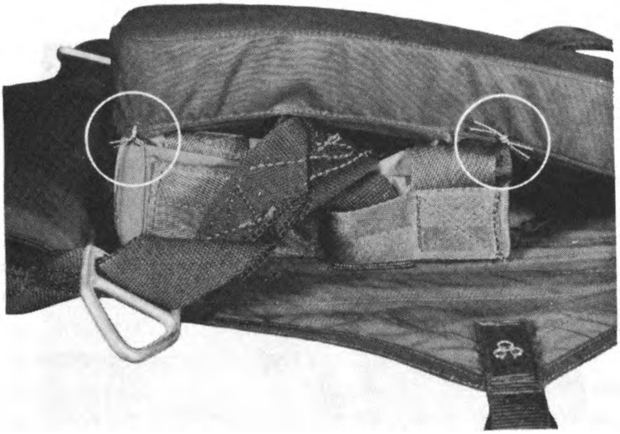


Figure 4–109.—Seat cushion side tackings.

Prepare the parachute for packing. Pass the free end of the ripcord housing through the side keeper in the pararaft kit container and through the harness sleeve. (See fig. 4–111.)

If the pocket is not in its proper position on the harness, it will require a readjustment after the parachute has been packed. The extensible ripcord and housing should be the only type used when the parachute is rigged with the para-

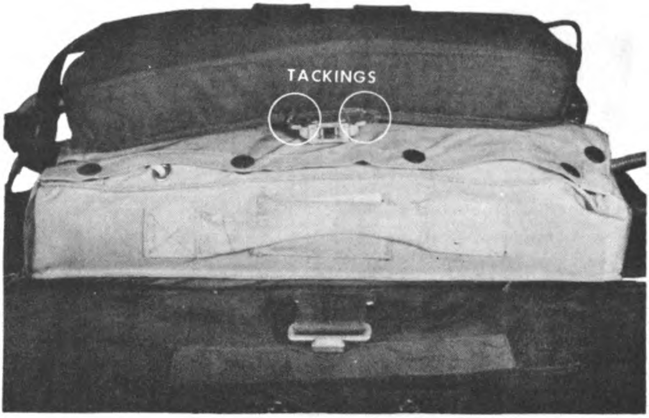


Figure 4–110.—Forward seat cushion tackings.

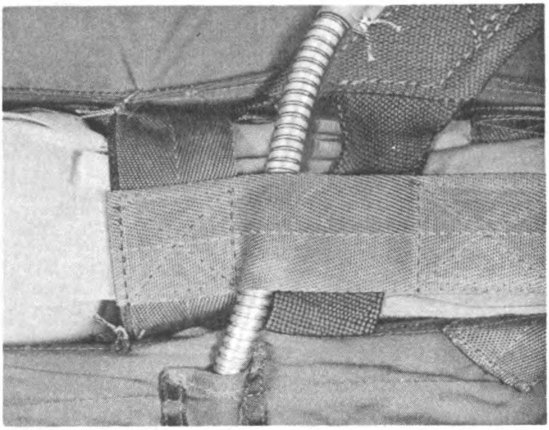


Figure 4–111.—Passage of the ripcord housing.

raft kit, as these assemblies afford the correct length for the additional thickness of the pararaft kit.

After the parachute has been packed, refer to figure 4–112 for complete rigging information to finish the project.

Always be certain to make the premature opening check. This is especially important now that the parachute is en-

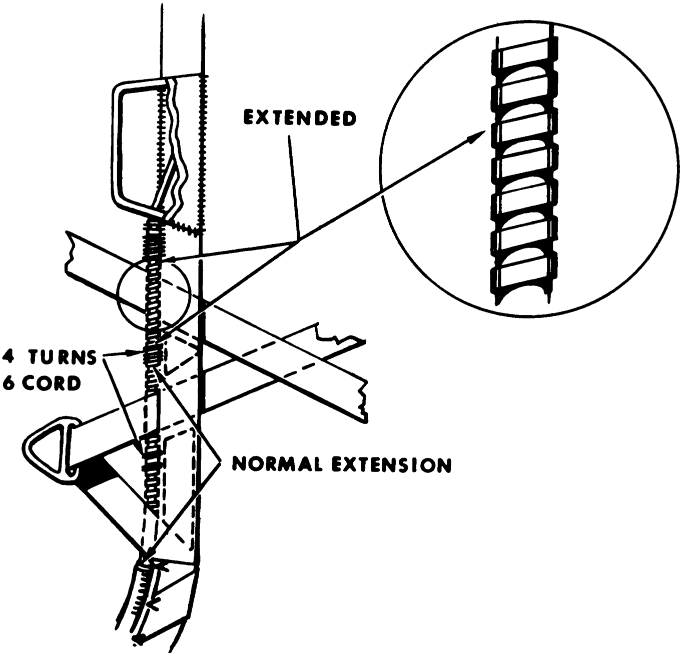


Figure 4–112.—Rigging instructions for locating and tacking ripcord housing and pocket.

cumbered with the additional weight of the pararaft kit. There is no need to worry about this additional encumbrance so long as the instructions have been followed and the parachute passes the premature opening test.

Rigging with a bail-out cylinder.—This equipment is supplied for the use of flight personnel undertaking extended or frequent flights above an altitude of 25,000 feet.

The bail-out unit consists of a cylinder, a metering orifice, a refill valve, a pressure gage, a ball pull handle, a caution tag and pin, a tube, and a mask adapter. When the caution tag is disengaged and the ball handle pulled, oxygen will flow through the orifice up to the mask adapter via the tube.

Complete information and the procedures involved in the maintenance and servicing of this equipment will be treated in the oxygen equipment section of volume 2 of this series.

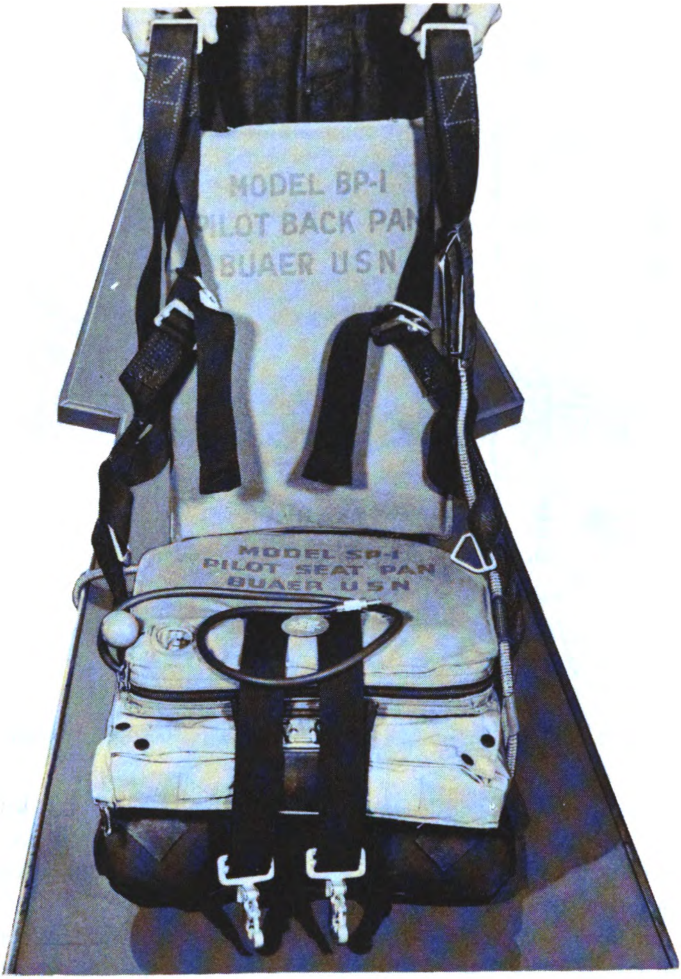


Figure 4–113.—H–2 emergency bail-out cylinder installed in the seat pan on the seat type parachute.

The oxygen cylinder assembly is installed in the SP–1 seat pan attached to the seat type parachute. It is positioned near and parallel to the leading edge of the seat pan so that the ball pull handle and tube end of the assembly is to the right. The pressure gage is visible through a reinforced opening in the top of the seat pan. (See fig. 4–113.) To accomplish this modification refer to applicable technical publications.

Back Type Parachute

PACKING AND RIGGING WITHOUT THE PARARAFT KIT.—Packing and rigging procedures for the back, chest, and seat type parachutes are similar in most respects. Therefore, since the differences in the major components of the assemblies are known to you, packing and rigging the back type parachute (NB3) should be quite simple.

The step-by-step procedures follow:

1. Clean the table.

2. Lay out the tools and equipment.

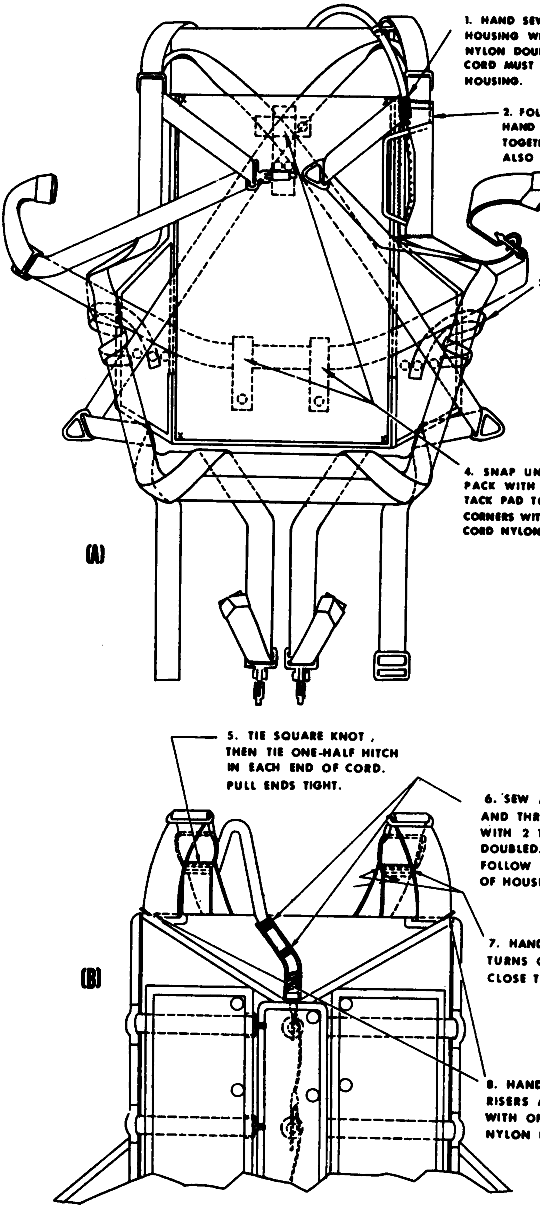
3. Lay out the parachute. Figure 4–114 illustrates the rigging diagram for the back type parachute.

Attach the pack to the harness. (See fig. 4–115.)

Attach the ripcord housing to the pack and the grip pocket. Do not secure the pocket to the harness with top and bottom tackings until after packing the parachute. Attach the wing straps of the pack to the harness. Secure the pararaft retaining straps. (See fig. 4–114.)

A back type cushion, which has been developed for universal use (shown in fig. 4–116) on service type parachutes, shall be used. The cushion is installed on the body side of the harness in a manner similar to the installation on the seat type, except that the lift web keepers are not used but are snapped in place to avoid entanglement. The cushion is tacked with 6-cord nylon in four places close to the corners. These tackings pass completely through the container or pack and must be made while the parachute is in an unpacked condition. The two tackings at the top end shall also pass through the main sling to aid in giving rigidity to the assembly. Tack the lift webs with one turn of size "E" nylon thread, doubled, to the top edge of the pack.

4. When rigging procedures are begun with a completely unrigged parachute, many of the inspecting and repair procedures will be closely combined with the rigging proce-



1. HAND SEW AN6570-2A RIPCORD HOUSING WITH 6 TURNS OF 6 CORD NYLON DOUBLED, PULLING TIGHT. CORD MUST FOLLOW GROOVES OF HOUSING.

2. FOLD POCKET AROUND SLING. HAND SEW EDGES OF POCKET TOGETHER WITH 6 CORD NYLON ALSO HANDSEW BOTH ENDS OF POCKET TO HARNESS. LOCATE POCKET TO SUIT RIPCORD HAND PULL AND HOUSING. MAKE STRONG FINISH.

3. WRAP STRAP ON PACK WING AROUND HARNESS BETWEEN LEG STRAP LOOP, BACK STRAP AND THROUGH BACK STRAP SLOT.

4. SNAP UNIVERSAL BACK PACK TO PACK WITH AVAILABLE KEEPERS. TACK PAD TO PACK CLOSE TO FOUR CORNERS WITH 2 TURNS OF SINGLE 6 CORD NYLON.

5. TIE SQUARE KNOT, THEN TIE ONE-HALF HITCH IN EACH END OF CORD. PULL ENDS TIGHT.

6. SEW AROUND HOUSING AND THROUGH PANEL WITH 2 TURNS OF 6 CORD DOUBLED. CORD MUST FOLLOW WITH GROOVES OF HOUSING

7. HANDSEW WITH 2 TURNS OF E NYLON CLOSE TO CORD

8. HANDSEW THROUGH RISERS AND PACK PANEL WITH ONE TURN OF E NYLON DOUBLED.

Figure 4–114.—Rigging diagram for the back type parachute.

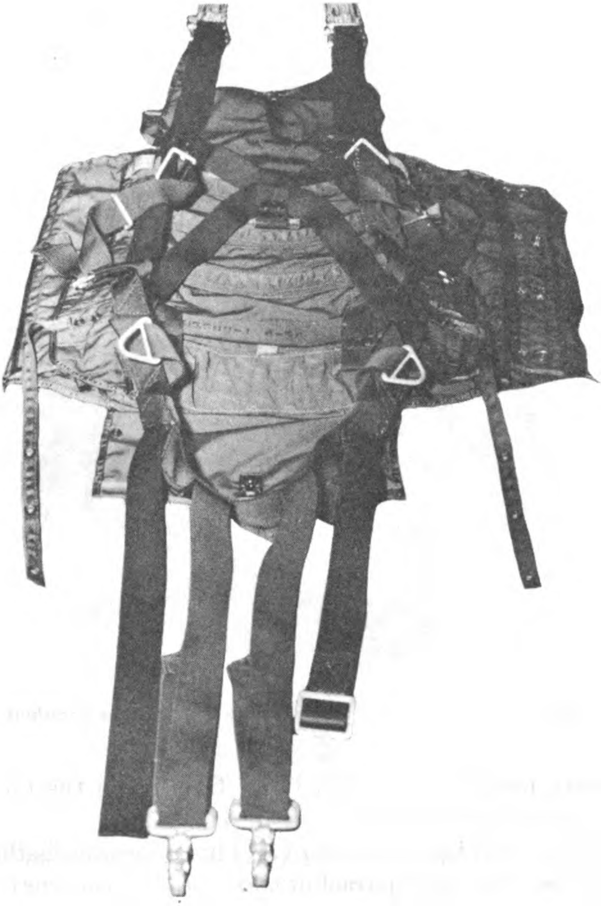


Figure 4–115.—Attachment of the back type parachute pack to the harness.

dures. It is very difficult to know exactly when to draw the line to show where inspection and repair methods stop and rigging procedures begin, as they are so closely linked. The best rule to follow is: ALWAYS INSPECT AND REPAIR, IF NECESSARY, EACH AND EVERY ASSEMBLY BEFORE ATTACHING IT TO THE PARACHUTE.

5. Hook up the parachute. Figure 4–116 illustrates a method of engaging the parachute under tension. The parachute is laid out and held under tension with the harness in

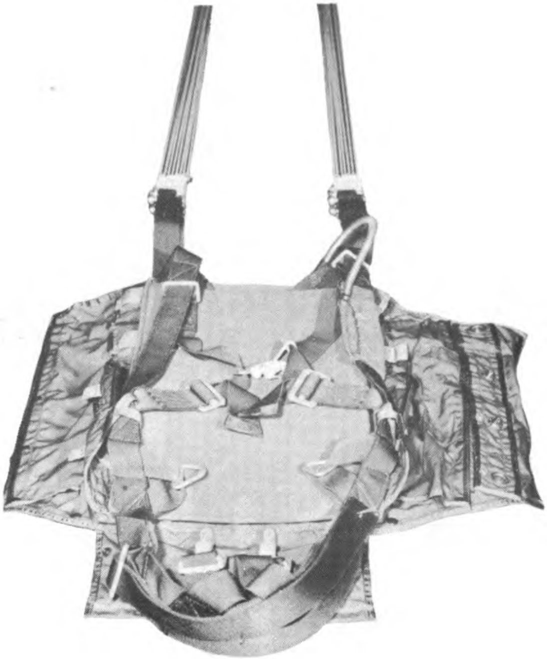


Figure 4–116.—Method of hooking up the back type parachute.

the body position of a man lying face up on the table, his head toward the canopy.

6. Whip and fold the canopy. This procedure is the same as for the chest type parachute, except that the final folded width of the canopy should conform to the width of the back pack which is wider than the chest pack.

7. Unhook, tack the links over the second frame from the bottom, using one turn of size "E" nylon thread for each two links, and sign the inside Parachute Record Card.

8. Insert suspension lines in the pack. Insert lines in the first hesitator loop as shown in figure 4–117.

All but approximately 18 inches of the suspension line length is stowed through the hesitator loops. (See fig. 4–118.) The skirt is ready to be brought up on the pack.

9. Place canopy on pack. With the pack still in the same

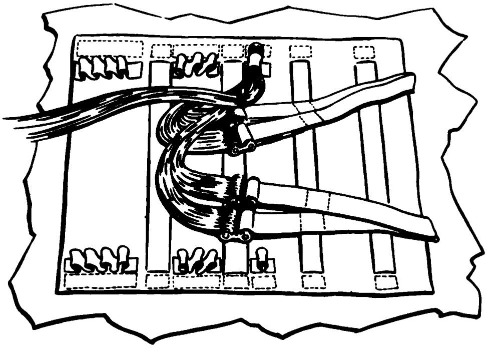


Figure 4–117.—First bight of suspension lines stowed in pack. Links of each group have been tacked down together in the center of the pack with one turn "E" nylon doubled.

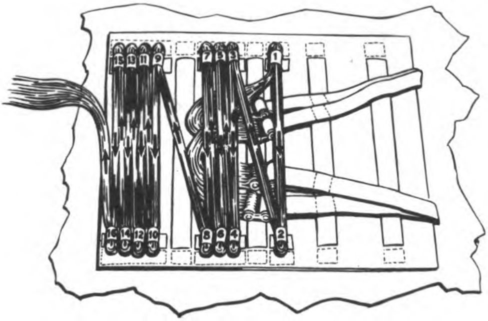


Figure 4–118.—Suspension lines stowed in the back pack.

position, lift the skirt and move it up to the opposite end of the pack. This is the top edge of the pack. The canopy is accordion folded on the container, as previously described for the chest type parachute. Since the back type parachute pack is longer than the chest type, not as many folds will be required to completely fold the canopy.

10. Position the pilot chute and prepare to close the pack.

11. While holding the pilot chute compressed and in place, bring up the side flaps and insert two temporary locking pins in the center locking cones to hold the sides closed. The pack may be turned or left lying parallel to the table's

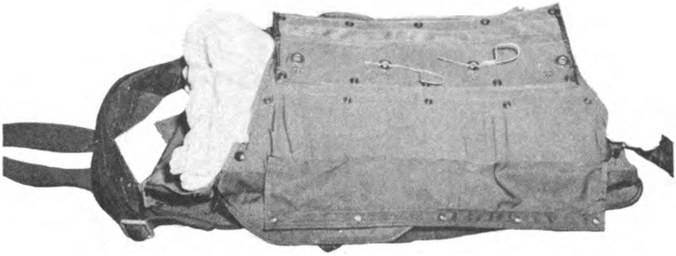


Figure 4–119.—Side flaps held by temporary locking pins.

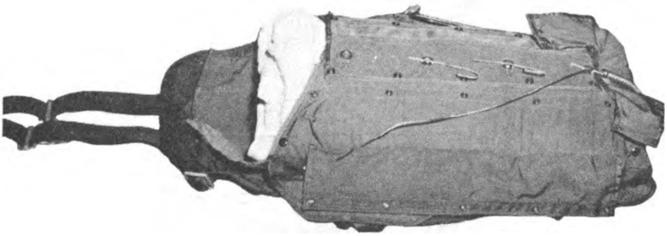


Figure 4–120.—Pack held closed by top ripcord pin and two temporary locking pins.

length while the sides are being brought up and secured. (See fig. 4–119.)

Straighten the canopy fabric and insert the locking cone located on the top end flap through the corresponding pack grommet as shown in figure 4–120, then insert the top ripcord pin.

12. Remove the temporary locking pins as the remaining ripcord pins are inserted in the locking cones. The bottom end flap contains the last locking cone which is passed through the bottom grommet of the pack and secured by the last ripcord pin. Insert the ripcord grip in its pocket. Straighten the end flaps of the pack using a fid. Fasten the corner snaps. (See fig. 4–121.)

13. Safety tie the last, or bottom, ripcord pin.

14. Hook up the opening bands and fasten the ripcord protector flap.

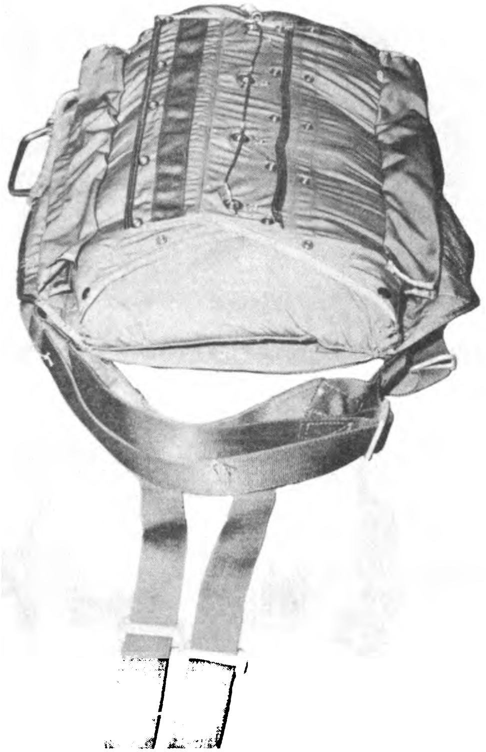


Figure 4–121.—Sides and ends of pack closed, ripcord in place.

15. Slide the ripcord pocket along the harness to the position indicated in the rigging diagram. (See fig. 4–114.) Grasping the ripcord pocket and harness with the fingers through the ripcord grip, jerk the harness outwardly away from the parachute pack. This will test the position of the ripcord grip pocket on the harness.

Warning: Do not misplace the grip pocket. The proper adjustment of an inflexible ripcord to the flexible fabric parts of a parachute is vitally important.

Secure the ripcord pocket to the harness after adjustments have been made. (See fig. 4–114.)

16. Sign the Parachute Record Card and make a corresponding entry on the Parachute History Card.

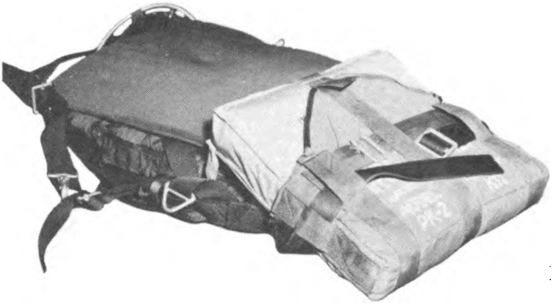


Figure 4—122.—Retaining straps passed through side and bottom keepers

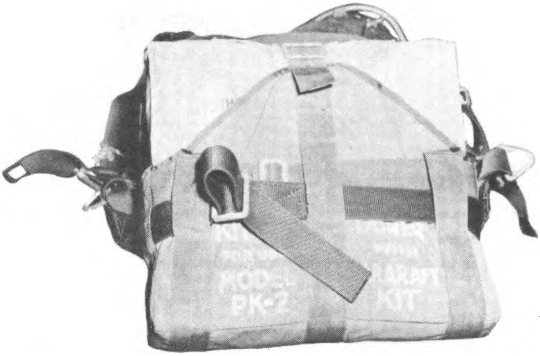


Figure 4—123.—Adapter retaining strap passed through bottom center keeper and opposite retaining strap passed through adapter in preparation for drawing main sling and pararaft kit container together.

Wearing and adjustment.—The principles of adjustment of the quick fit parachute harness are the same regardless of the type of parachute attached. Adjust the back pack so that it is carried high on the back. This parachute is shown properly worn and adjusted in chapter 2.

Packing and rigging with the pararaft kit.—Rigging the back type parachute with a pararaft kit is a simple procedure in comparison with the same task on the seat type parachute. There is no ripcord replacement problem here, and the changeover can be accomplished while the parachute remains in a packed condition.

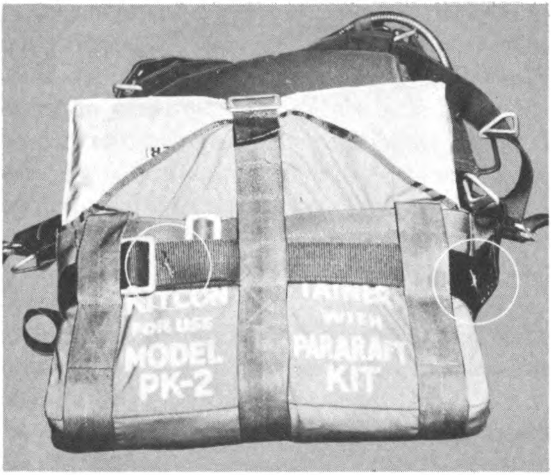


Figure 4–124.—Adjustment made and free end of retaining strap tacked to harness. Second tacking is also made close to adapter and on free side to hold the adjustment.

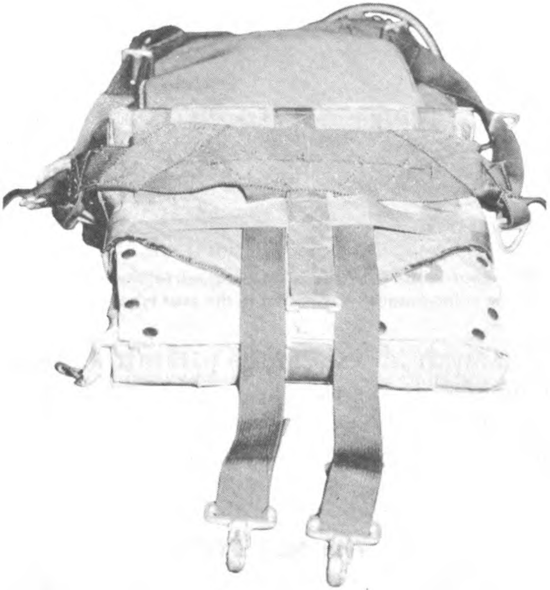


Figure 4–125.—Leg straps passed through keepers on the kit container. This is a very important step as this operation will retain the pararaft kit in its proper position.

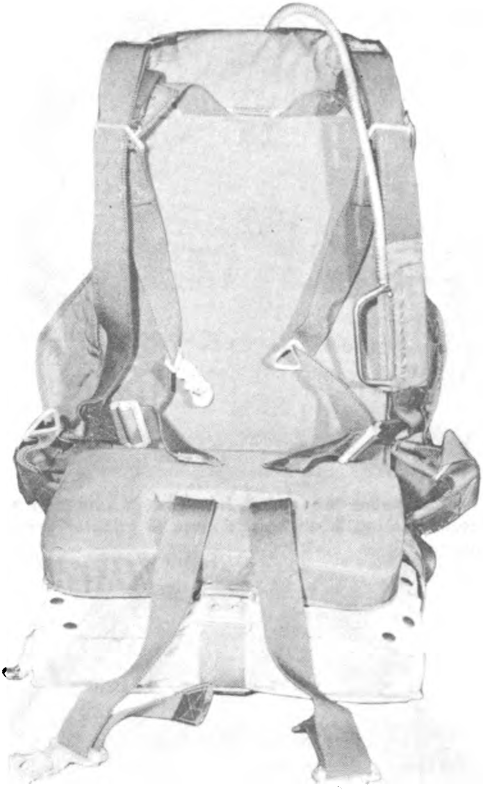


Figure 4–126.—Seat cushion in place and tacked to the pararaft kit container in the same manner as applied to the seat type parachute.

Fit the pararaft kit case to the pararaft kit container in the same manner as for the chest and seat type parachutes. Secure the adjustments with tackings. Release the pararaft retaining straps and proceed in accordance with figures 4–122 through 4–126.

THE NB4 TYPE

The 22-gore 26-foot conical back parachute (NB4–R and O) incorporates several new innovations hitherto not found in Navy personnel parachutes. The canopy has been changed from a 28-foot hemispherically shaped unit to a 26-foot conical assembly, thereby reducing the bulk of the folded parachute. A slide fastener closure has replaced the grommet and cone system which tends to reduce bulk in the final packing. The conventional pack opening bands, with the exception of one, have been replaced with strips of spring steel embedded in the walls of the pack. These springs, under tension when the parachute is in a packed condition, exert the necessary force to open the pack when the slide fastener closure is released.

The 26-foot parachute, by virtue of its new features and design, calls for a slightly new technique in parachute packing which is described in the following pages:

Lay the parachute on the table and straighten the harness. Check to see that the pack opening band is securely held at its center over the top pack stiffener. (See fig. 4–127 (A).) If the pack opening band is not secured, it can be fastened at the top center of the pack by means of a tightly drawn loop of 3-cord nylon thread encircling the stiffener. Tie off with a surgeon's or fisherman's knot on the outside of the pack. Do not pierce the covering of the pack opening band.

Have the ferrule flange seated firmly against the clamp, tighten the clamp screw, and tack the ferrule to the edge of the pack with 3 turns of double 3-cord nylon thread. (See fig. 4–127 (B).)

Check to see that the pack opening band passes through the tape channel provided on each side of the pack. (See fig. 4–127 (C).)

Extend the parachute and hook it up with the inside surface of the pack upward and the bottom edge of the pack farthest from the canopy. The harness, which is attached to the pack, will assume a position relative to a man lying face down, head toward the canopy.

After whipping and folding the canopy in the conventional manner, bring the lift webs in over the top edge of the pack, lay the connector links over the second or third stiffener from the bottom and arrange as shown in figure 4–128. Hand tack the links in PAIRS through the tape which houses

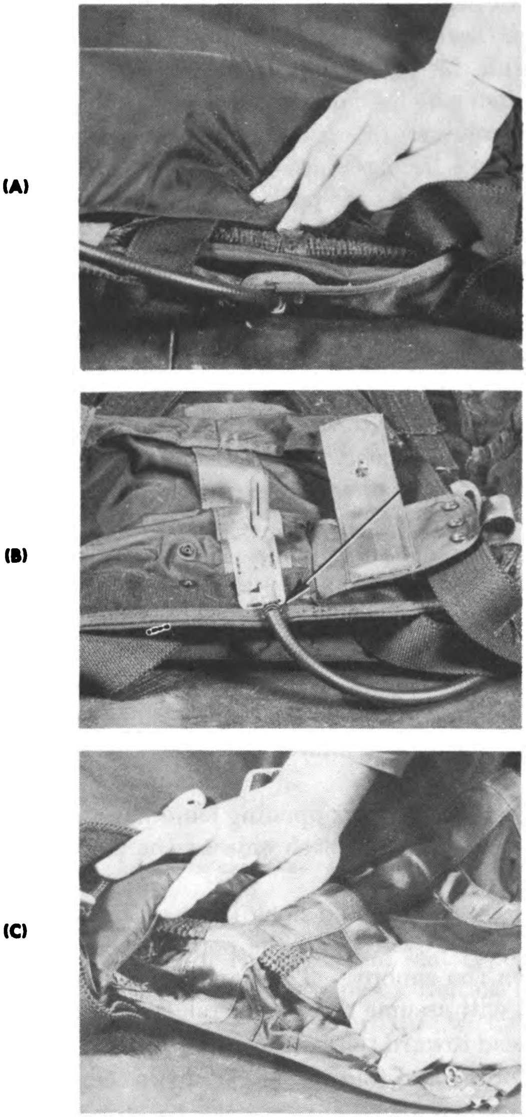


Figure 4–127.—(A) Pack opening band held securely at the center.
(B) Ferrule tacked to the edge of the pack.
(C) Pack opening band must pass through channel provided on each side of the pack.

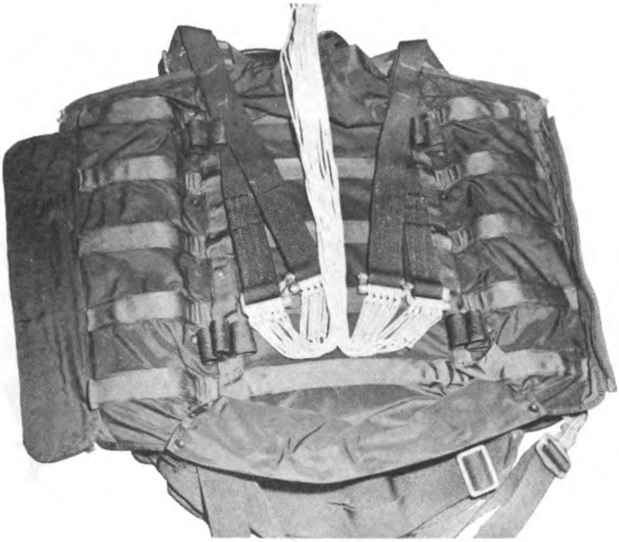


Figure 4–128.—Connector links tacked prior to making first loop.

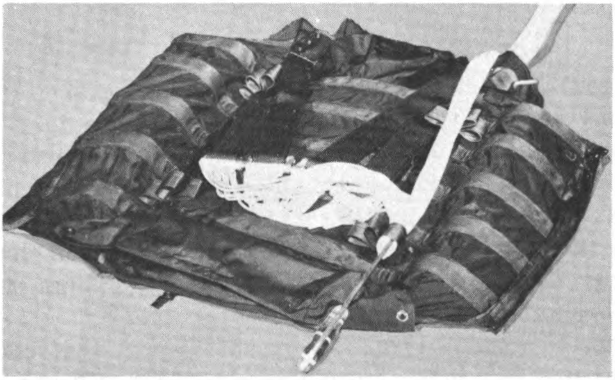


Figure 4–129.—Making first loop.

the stiffener, using one turn of 3-cord nylon thread or a double turn of size "FF" nylon thread. (See fig. 4–128.) With the links secured to the tape over the second or third stiffener, arrange the lines as shown and prepare to stow the lines in the retainer loops.

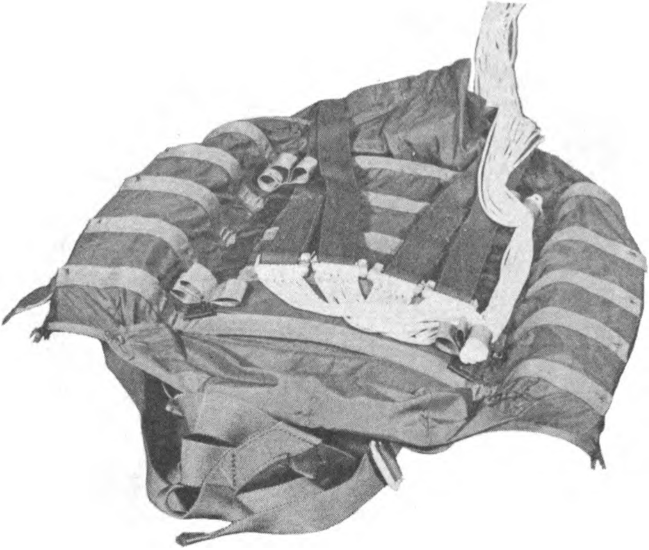


Figure 4–130.—Lines stowed in loops 1 and 2.

Note that the lines enter the pack from the top.

Draw the lines through loop number 1. (See fig. 4–129.)

When the lines are properly seated in loop number 1 and all remaining loops, they should protrude from each loop about 3/8 of an inch. Stow the suspension lines NEATLY. Draw the group of lines to loop number 2 and pull through retainer making certain not to dislodge the lines stowed previously. (See fig. 4–130.)

After the lines have been drawn through the retainers from 1 to 6, bring them over the lift webs or risers to loop number 7, and continue the line stowage until the last retainer, number 12, is used. (See fig. 4–131.)

Bring the skirt section to the bottom of the pack. Spread the skirt hem to the proper width and stagger the suspension lines where they enter the skirt in order to eliminate bunching of these joints. (See fig. 4–132.)

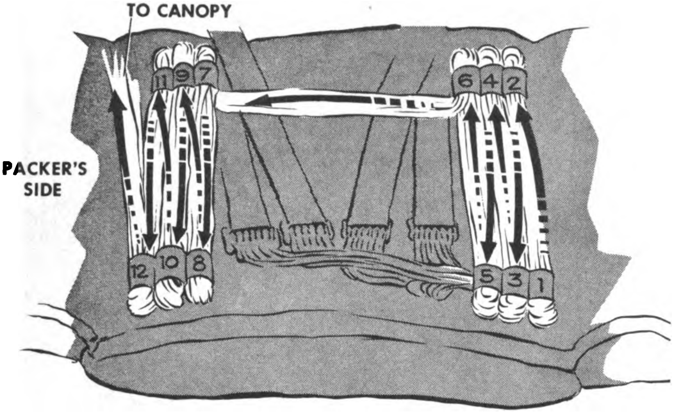


Figure 4–131.—The suspension lines are now properly stowed in the 12 retainer loops.

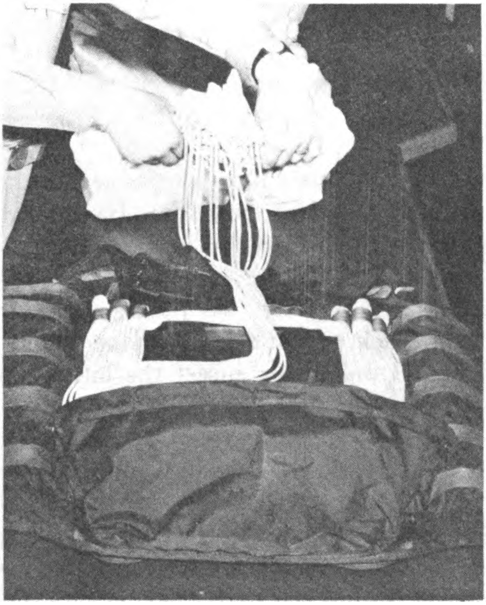


Figure 4–132.—Spread skirt and stagger the joints made by the suspension lines.

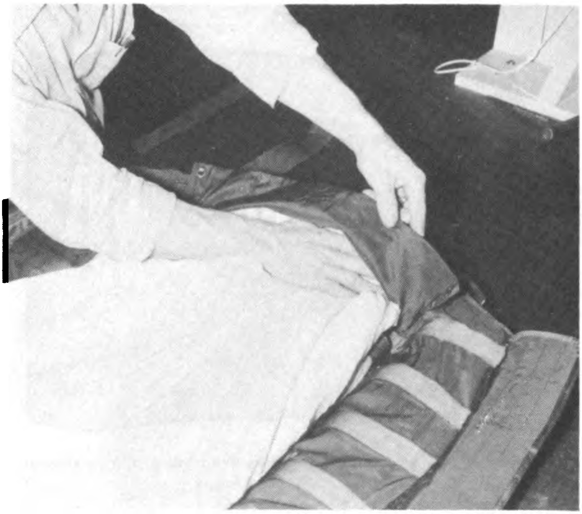


Figure 4–133.—Insert the skirt into the pocket.

The steps in packing shown in figures 4–133 to 4–149 are demonstrated by an employee of the Navy Air Material Center, Philadelphia, Pa.

Insert the skirt bottom into the pocket at the bottom of the pack as uniformly as possible. Be certain to fill the corners of the pocket, thereby making use of all available space. (See fig. 4–133.)

Fluff the canopy slightly. At points approximately midway down the pack and at the top make folds as shown in figure 4–134 and uniformly insert the latter half fold into the pocket directly over the skirt edge.

Dress up or straighten the work done thus far. Fluffing the canopy during folding permits a more economical use of the packing area and easier closing of the pack in the final stages of the operation. (See fig. 4–135.)

With the skirt edge and the latter half fold neatly tucked into the pocket, secure the snap fastener on each side of the pocket. (See fig. 4–136.)

Prepare another fold as shown in figure 4–137. This fold

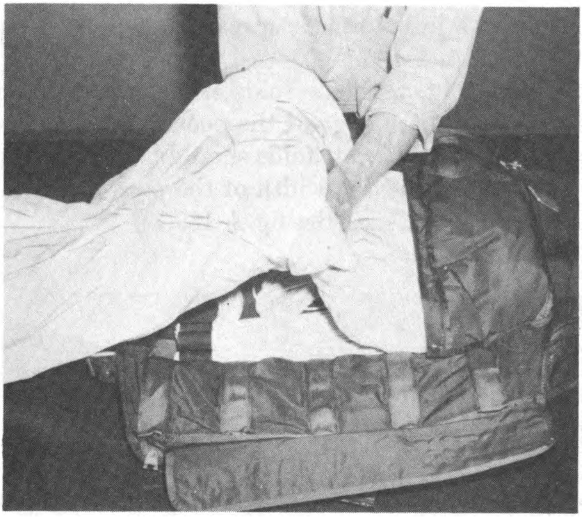


Figure 4–134.—Making the short fold to be tucked into pocket.

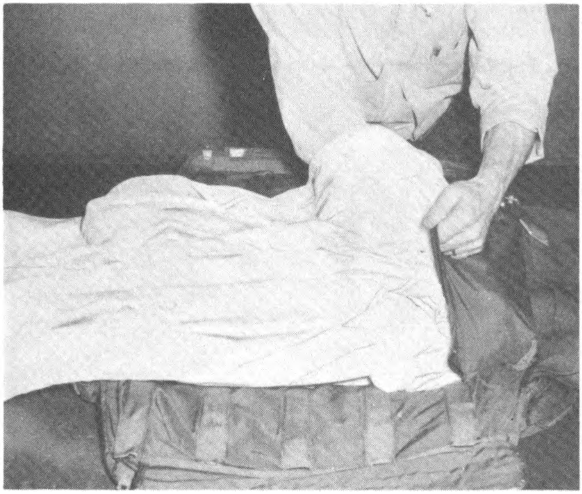


Figure 4–135.—Inserting the short fold.

shall be brought to the top edge of the pocket. Note how the canopy is fluffed and spread.

With the fold just formed, spread the canopy material as shown in figure 4–138.

Continue folding, with the folds extending from the top edge of the pack to the edge of the pocket, until the canopy peak has been reached. All folds should be spread approximately 3 inches beyond the width of the pack to fill the side edges of the closed pack. (See fig. 4–139.)

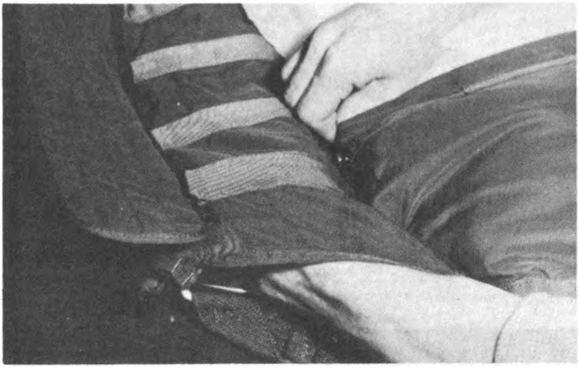


Figure 4–136.—Secure snap fasteners, one on each side of pocket.

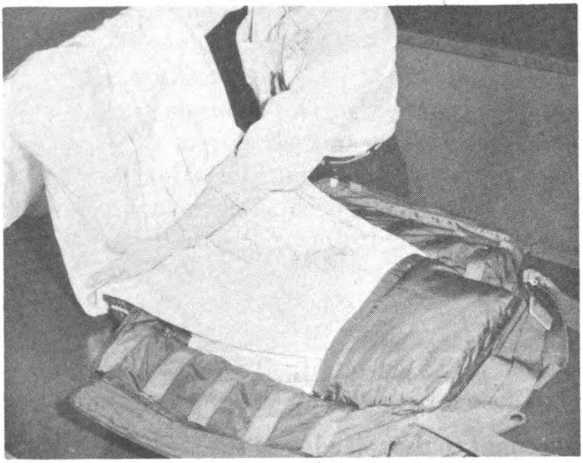


Figure 4–137.—Making fold to be brought to top edge of pocket.

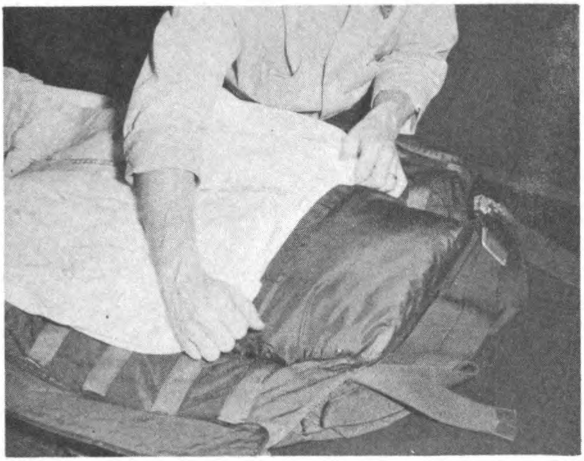


Figure 4–138.—Spread the fold to extend beyond the width of the pack for approximately 3 inches.

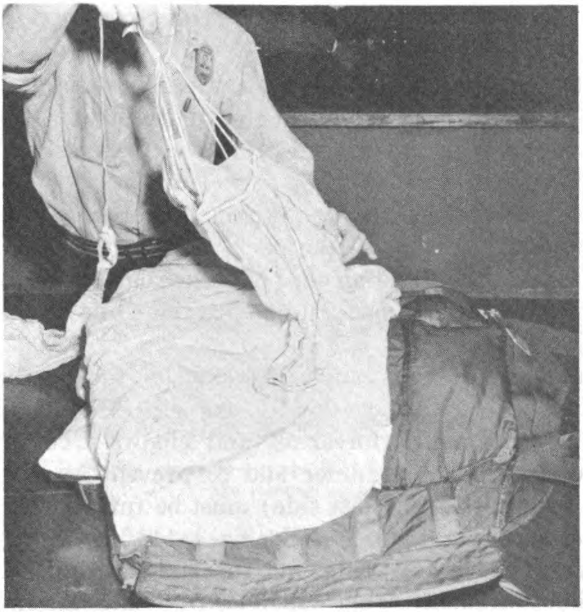


Figure 4–139.—Making the last fold as peak is reached.

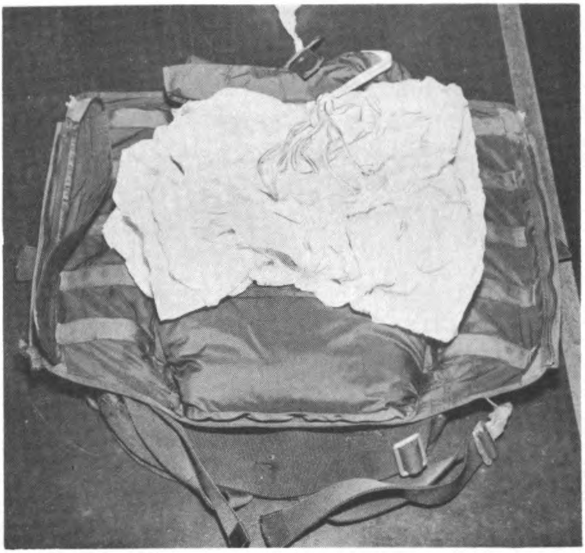


Figure 4–140.—Canopy folded into pack.

At this point, the pilot chute is all that remains outside the pack and it is time to begin closing the pack. The pilot chute tie cord should extend from the pack as indicated. (See fig. 4–140.)

Attach the fastener slider, which is stored in the slider pocket on the exterior of the pack, on the right side of the chain. Insert the holding cord hooks through the grommets at the bottom of the pack and secure the cords to the table. (See fig. 4–141.)

After spreading the canopy toward the sides of the pack, bring the side flaps together to engage the slide fastener by using the hands, forearms, and elbows. To properly engage the chain and slider and to prevent misalignment of the scoops, the pin (left side) must be fully seated in the retainer unit (right side). (See fig. 4–142.)

Having successfully engaged the slider, begin to secure the slider fastener. This will require manipulation of the elbows, forearms, and hands to overcome the force exerted

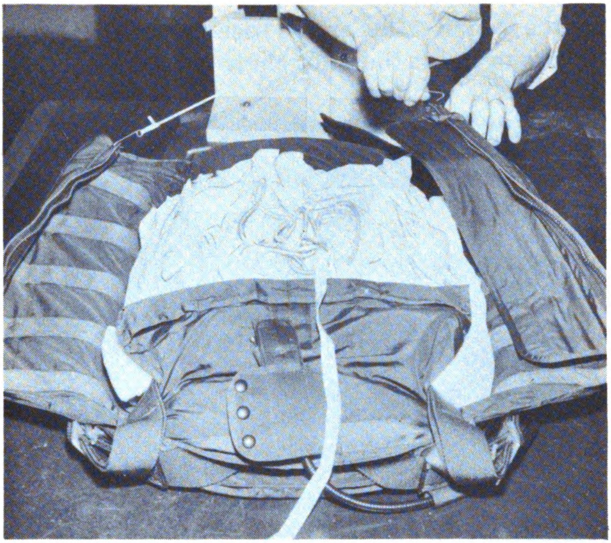


Figure 4–141.—Secure holding hooks after attaching slider.

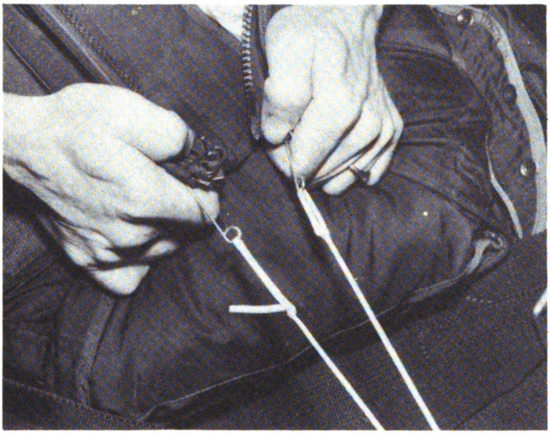


Figure 4–142.—Getting ready to engage the pin through the slider and into the retainer unit.

by the pack stiffeners which act as spring openers. Pull the slider for short distances at a time, each time reestablishing the grip held on the pack. Note the position of the hands and arms; this is important. (See fig. 4–143.)

When the second stiffener has been reached, lock the slide and prepare to insert the pilot chute. (See fig. 4–144.)

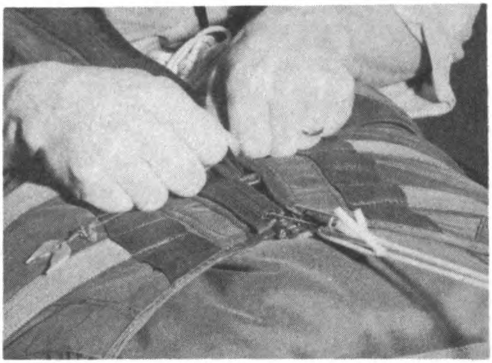


Figure 4–143.—Closing the chain.

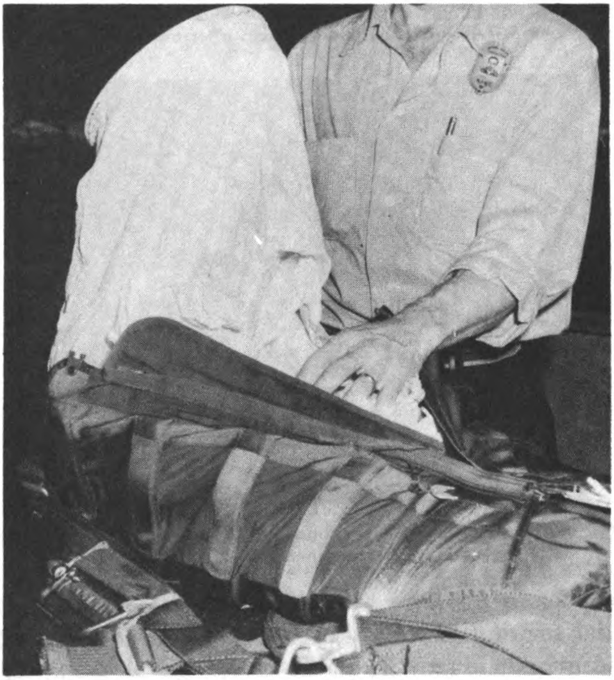


Figure 4–144.—Inserting the pilot chute.

Raise the pilot chute over the central portion of the pack and compress the spring. (See fig. 4–145.)

With the coil springs fully compressed, slide the pilot chute inside the pack and locate it at the central portion of the pack under the middle stiffener. (See fig. 4–146.)

Resume closing the pack by pulling the slider for short distances, each time reestablishing the grip on the pack.

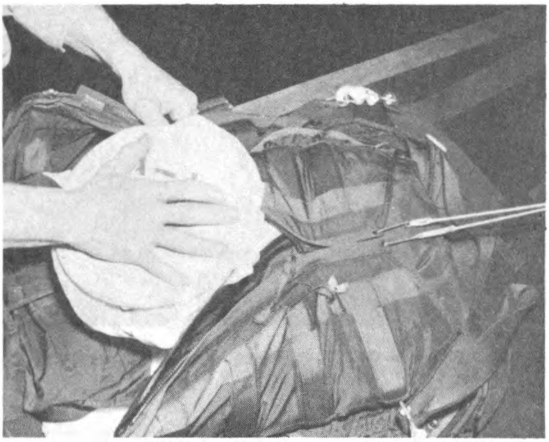


Figure 4–145.—Compress the pilot chute.

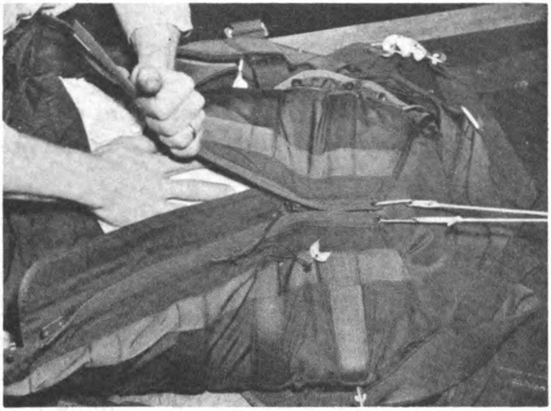


Figure 4–146.—Final stowage step of the pilot chute.

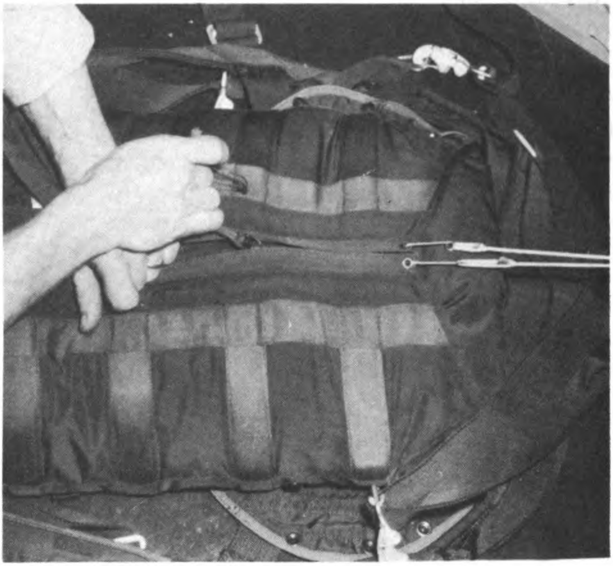


Figure 4–147.—Continue closing the pack.

Pulling the slider at a low angle will make closing the pack much easier. (See fig. 4–147.)

Just before the slider reaches the end of the chain, insert the key into the grommets, as shown in figure 4–148, to prevent separation of the chain fastener upon **REMOVAL OF THE SLIDER.**

Engage the beads of the slide fastener end plates with the ripcord end unit, as shown in figure 4–149. Note position of key.

Slip the ripcord end unit down over the end plates to the fullest extent and then **REMOVE THE KEY.** (See fig. 4–150.)

Safety tie the ripcord end unit through a grommet in the end plate, using size "A" nylon thread as shown in figure 4–151.

Position the wire eye between the prongs of the socket and insert the ripcord pin through the combination of both units as shown in figure 4–152.

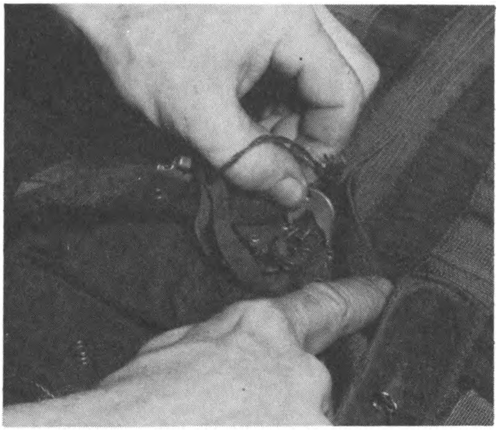


Figure 4–148.—Insert key or bridge keeper temporarily to prevent the pack from opening before removing slider.

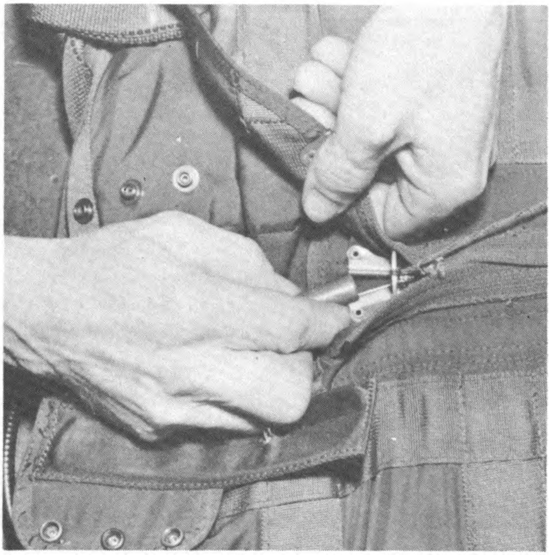


Figure 4–149.—Engage ripcord end unit with slide fastener end plates.

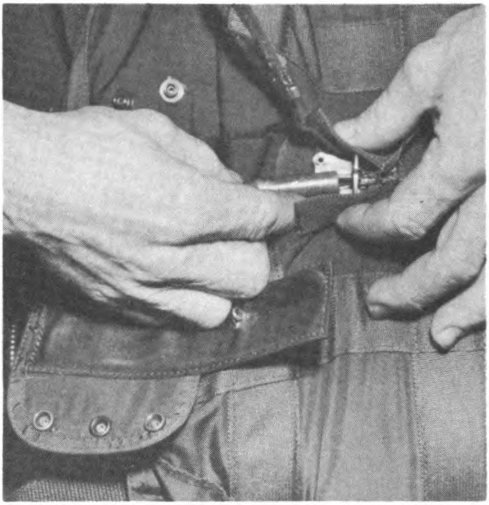


Figure 4–150.—Fully engage the ripcord end unit and slide fastener end plates.

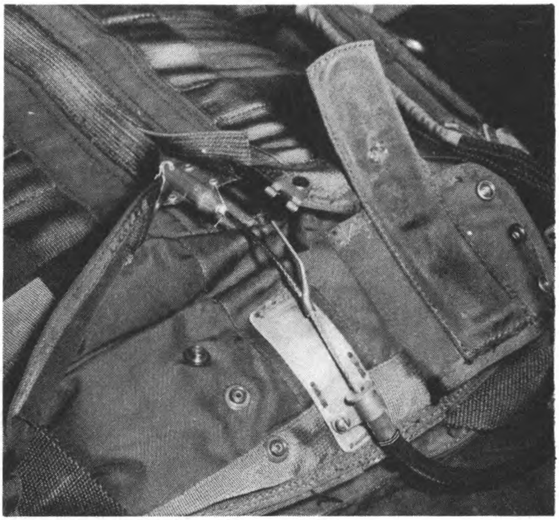


Figure 4–151.—Safety tie ripcord end unit to end plate.

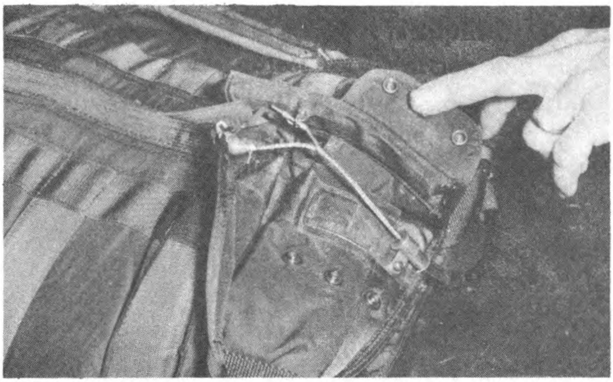


Figure 4–152.—Ripcord pin inserted through prongs of socket and loop of wire eye.

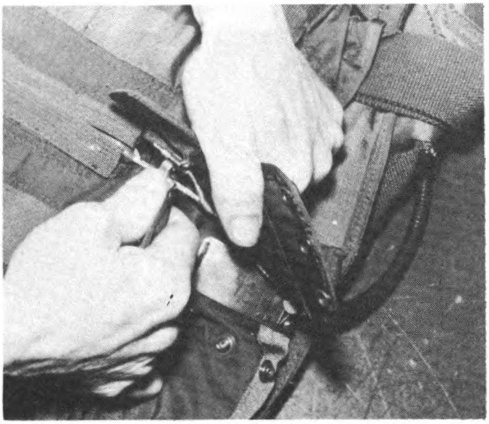


Figure 4–153.—Engaging the hook.

Engage the hook over the portion of the ripcord pin lying between the prongs of the socket while sliding the loop of the eye up along the pin. This operation is made possible by holding the hook in a vertical position for engagement. (See fig. 4–153.)

The ripcord pin, hook, socket, and eye are now properly assembled. (See fig. 4–154.)

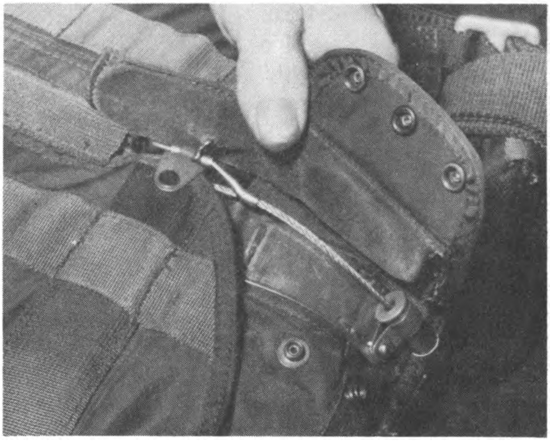


Figure 4–154.—Top elements engaged.

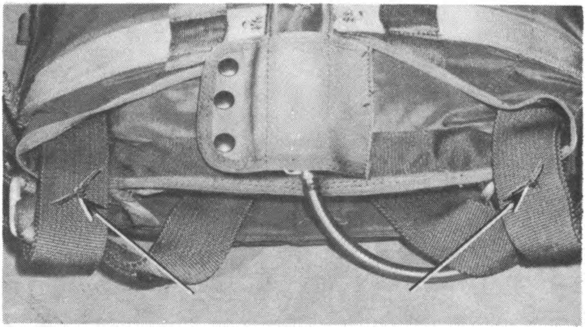


Figure 4–155.—(A) Exterior lift web tackings.

Tack lift webs to the PACK SUPPORT STRAPS one inch above the attachment point of the support straps to the pack using one turn of double 3-cord nylon thread. (See fig. 4–155 (A).) Figure 4–155 (B) shows the protector flap being snapped in place. Figure 4–155 (C) illustrates hooking up the pack opening band.

Figure 4–156 illustrates the parachute completely packed.

The KEY and SLIDER POCKET is provided to RETAIN the KEY and SLIDER when the parachute is in a PACKED CONDITION. Since these items are essential to the performance of the

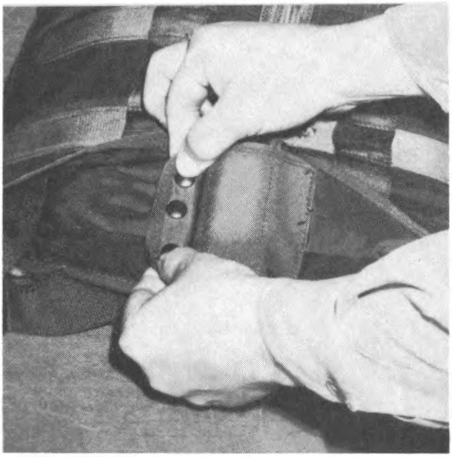


Figure 4–155.—(B) Snapping the protector flap.

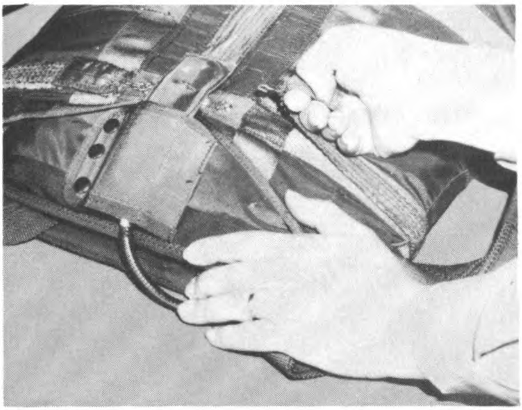


Figure 4–155.—(C) Engaging the oponing band.

packing operations, they should always be kept in the pocket when they are not being used. (See fig. 4–157.)

The Parachute Record Card pocket is located under the key and slider pocket and is not fitted with a snap fastener.

The NB4 assembly is the latest type parachute to be used by the Navy. Be especially on the alert for technical publications concerning this newly designed parachute.

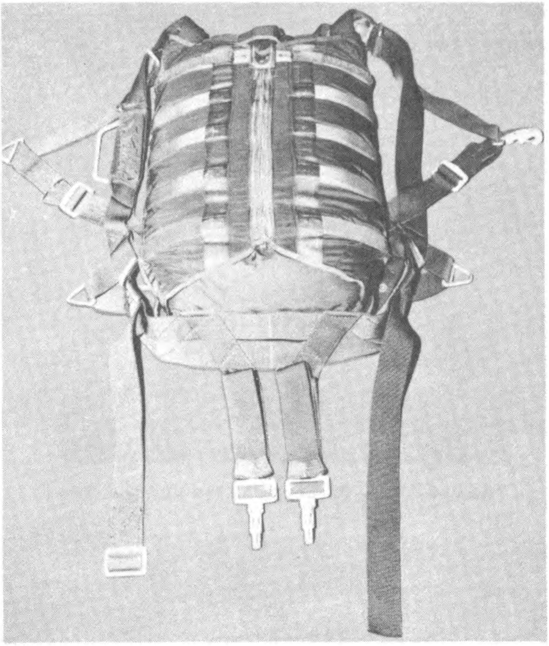


Figure 4–156.—NB4–R completely packed.

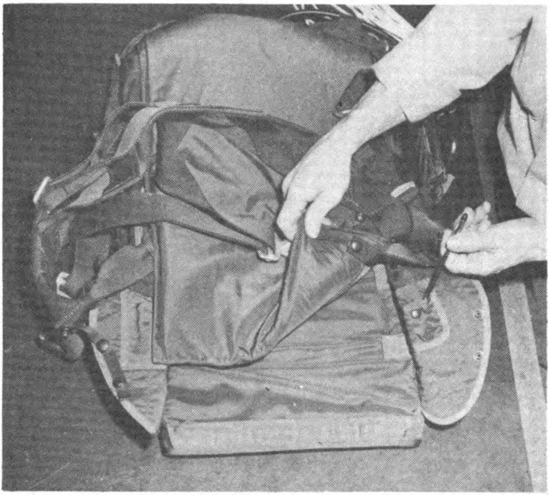


Figure 4–157.—Key and slider pocket.

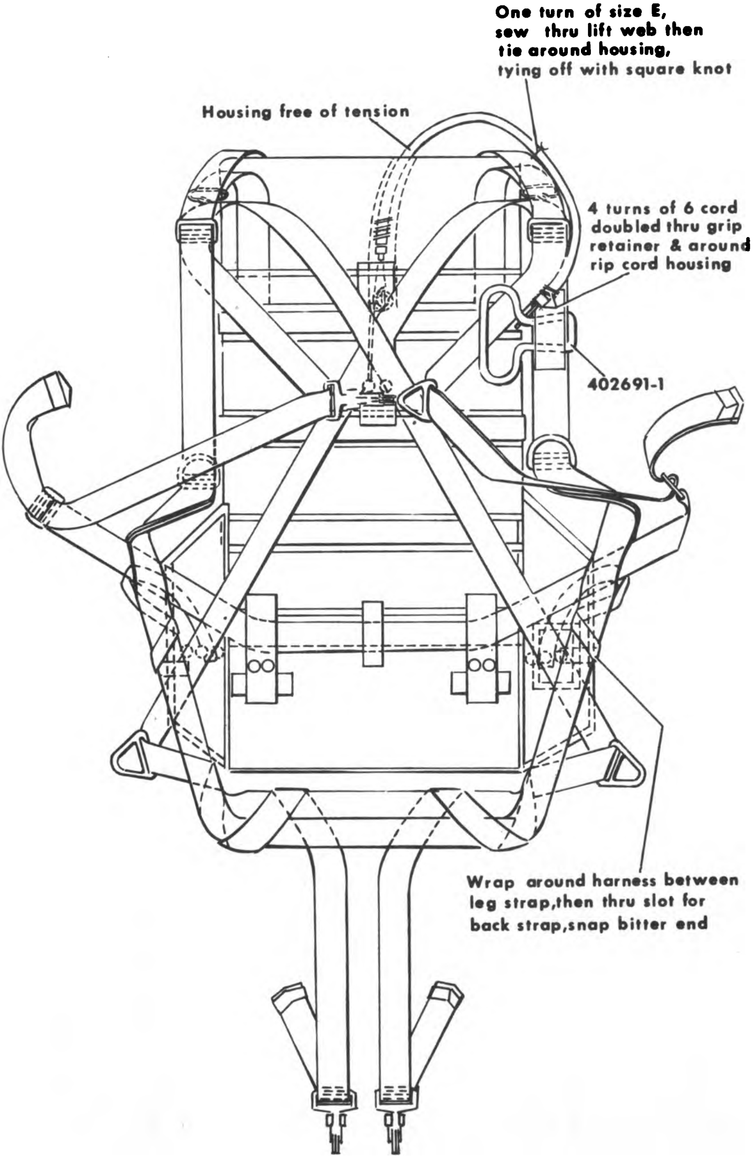


Figure 4–158.—(A) Rigging diagram for the NT4–R. (Front view.)

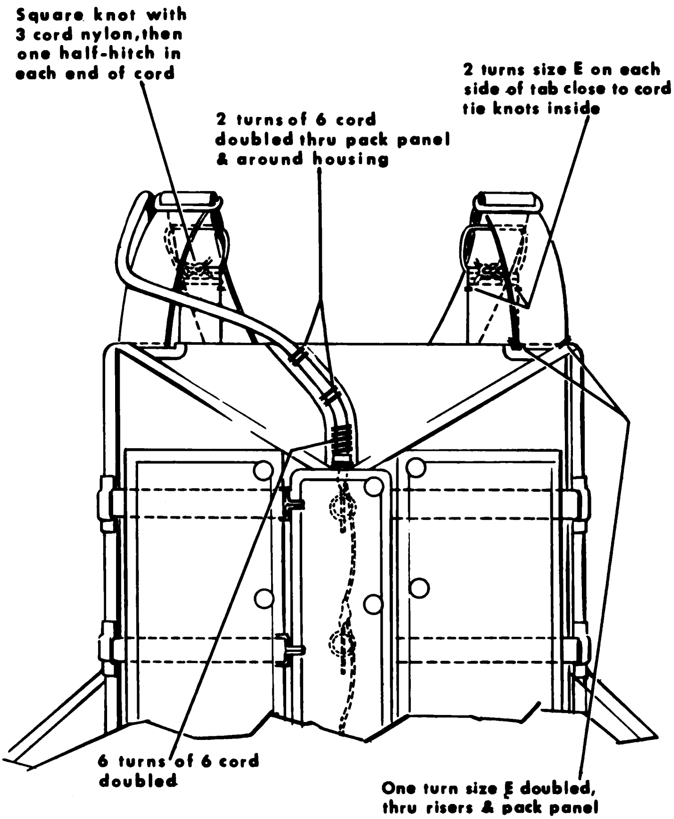

Square knot with 3 cord nylon, then one half-hitch in each end of cord
2 turns of 6 cord doubled thru pack panel & around housing
2 turns size E on each side of tab close to cord tie knots inside
6 turns of 6 cord doubled
One turn size E doubled, thru risers & pack panel

Figure 4–158.—(B) Rigging diagram for the NT4–R. (Back view.)

PACKING AND RIGGING THE TRAINING OUTFIT

The training outfit consists of two separate parachutes, a back type and a chest type. The back type parachute carries the harness and connecting hardware for engaging the chest type parachute.

Figure 4–158 (A) and (B) illustrates the rigging diagram for the NT4–R, training back type parachute. Study these figures thoroughly as the diagram contains all the in-

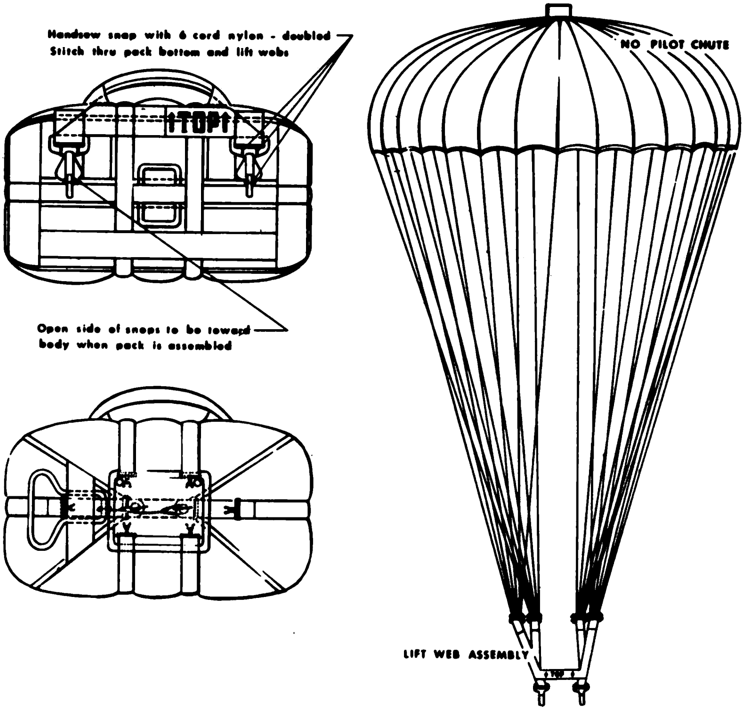

Handsew snap with 6 cord nylon - doubled
Stitch thru pack bottom and lift webs
TOP
Open side of snaps to be toward body when pack is assembled
NO PILOT CHUTE
LIFT WEB ASSEMBLY
TOP

Figure 4–159.—Rigging diagram for the NT4 parachute.

formation necessary to rig the NT4–R training back type parachute.

The packing method is essentially the same as for the NB3–R and therefore will not be repeated. When a 32-foot canopy is used, an oversized parachute pack and harness must be provided.

The chest unit of the training outfit, the NT4, utilizes the same canopy as the back unit, but the pilot chute is removed to prevent its fouling in the main canopy in the event that two parachutes have to be used during a jump. Figure 4–159 illustrates the rigging diagram for this type parachute.

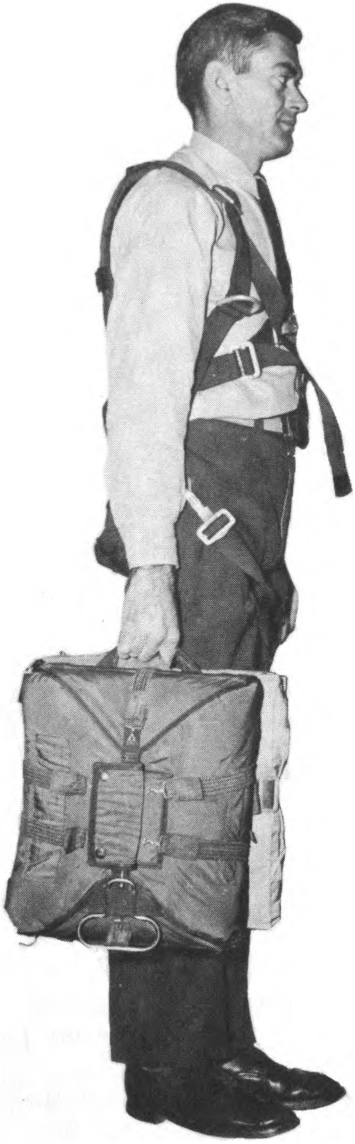


Figure 4-160.—Method of carrying the chest type parachute with and without the pararaft kit.

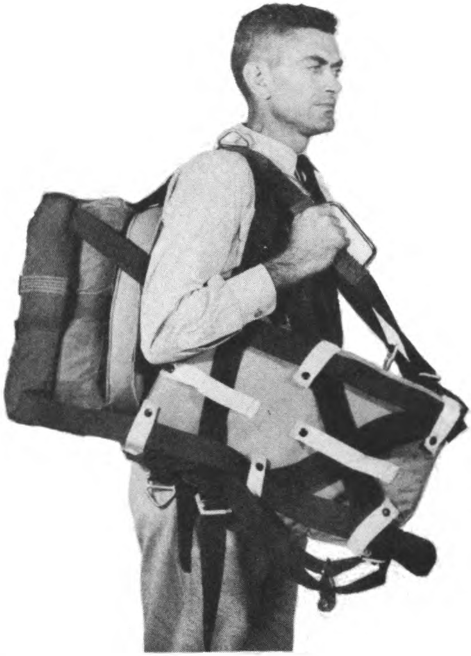


Figure 4–161.—Method of carrying the seat type parachute when rigged with or without the pararaft kit.

HANDLING PACKED PARACHUTES

The most effective way to explain the subject of handling packed parachutes is to list a series of general rules in the form of DO's and DON'TS.

1. Do not pick up a parachute by its lift webs or ripcord handgrip. Lift web tackings break relatively easy and when they do the suspension lines are almost certain of disarrangement. Carrying or attempting to carry a parachute by its ripcord grip will always result in a premature opening.
2. Do not place a parachute near any source of heat. Heat will cause brittleness in nylon fabric.
3. Do not place a parachute in or near any source of dirt,

grease, or oil. Stains can be extremely harmful to fabrics when they contain strong acids or alkalies.

4. Do not drop a parachute. Dropping a parachute can bend or break the metal components and perhaps cause failure of the entire assembly.

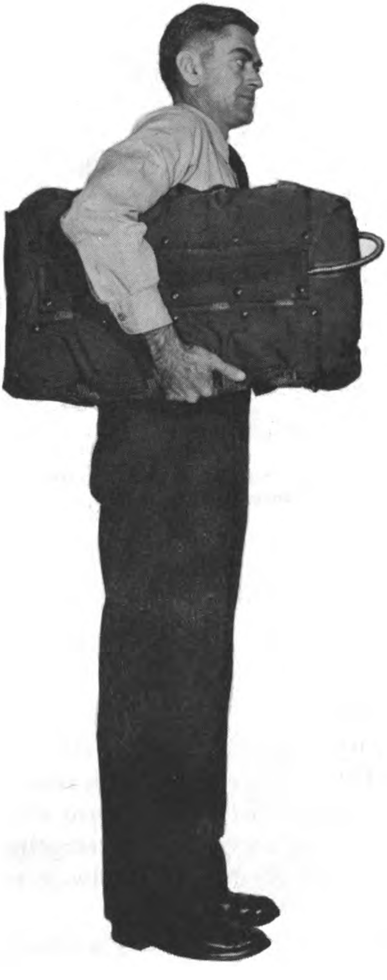


Figure 4–162.—Method of carrying the back type parachute without the pararaft kit.

5. Do not leave a parachute where it is likely to get wet.
6. Do not leave a parachute where heavy objects can be dropped or placed on it. Permitting a parachute to be carried in a cargo net along with squadron cruise boxes or similar gear displays poor handling techniques.
7. Use the chafing bag to cover the parachute when it is

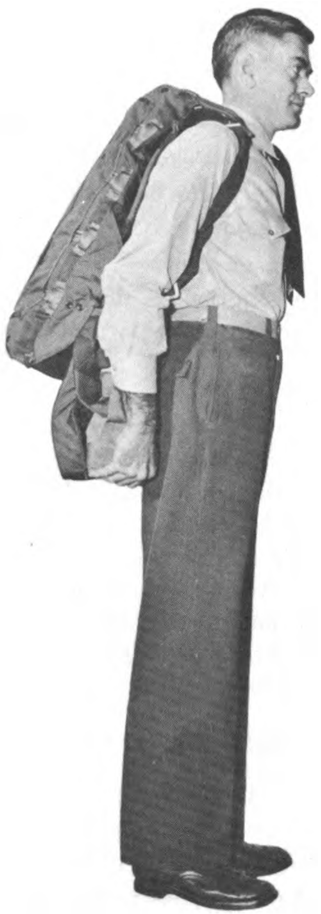


Figure 4–163.—Method of carrying the back type parachute when rigged with the pararaft kit.

expected to be kept out of service for a considerable amount of time.

8. Be prepared to give brief lectures instructing personnel on how to handle parachutes.

Figures 4–160 through 4–163 illustrate the best methods of carrying packed parachutes when rigged with and without the pararaft kit.

STOWING PARACHUTES IN CHAFING BAGS

The parachute chafing bag, closed with two long slide fasteners, provides ample stowage protection for the parachute in a packed or unpacked condition. The slide fasteners, when opened, offer a large cavity capable of receiving any standard size parachute. The basic rules for stowing a parachute in the chafing bag are:

1. Chain the suspension lines.
2. Place the harness in the bag first.
3. Let the pack act as the separator between the canopy and hardware.
4. Accordion pleat the canopy into the bag.
5. When appropriate, and for very short periods in transit, compress the pilot chute into the bag, using the side as a backstop for the top of the pilot chute. Otherwise, disengage the pilot chute and stow separately.
6. Be careful when closing the bag and do not catch the canopy fabric in the slide fasteners.
7. Do not stow the bag directly on the floor.
8. Make certain that the bag is properly stenciled or tagged for identification purposes.

ON THE FLIGHT LINE

Extra care must be given to the subject of handling packed parachutes on the line. Since the plane captains are the men who are most frequently required to handle the parachutes, other than Parachute Riggers, extra instruction should be directed to the plane captains in particular. It is part of your job as a Parachute Rigger to properly instruct the personnel who come in daily contact with lifesaving equipment. Acquaint every member of your squadron with the advantages as well as with the dangers involved in handling a packed parachute.

Cockpit enclosures are being improved for watertightness, but somehow rain does manage to enter the cockpit and settle in the bottom of empty bucket seats. Familiarize everyone with this fact and show them where you enter into this picture as well as themselves. Never place a parachute in a wet seat. Do not leave parachutes in aircraft exposed to the weather unless you or the plane captain have taken some added precaution to protect the parachute from water damage. Certain squadrons are often divided into detachments which operate in various localities away from the Parachute Rigger. The care of parachutes involved in these operations depends on how well you, the Parachute Rigger, have performed the job of familiarizing personnel with their parachutes.

Do not permit the plane captains to place a parachute on the wing or tail surfaces of an aircraft. This practice, if permitted, can lead to a great deal of extra work due to the damage inflicted by falls, dirt, and oil. Insist that the parachute be immediately placed in the seat of the cockpit.

Do not permit the parachutes to be hauled around on dirty bomb trucks, trailers, and the like. Discourage the practice of handling parachutes on plane tractors. This type of transportation neither offers a very stable platform nor is it clean.

Seat type parachutes rigged with a bail-out cylinder can be a big source of trouble if they are handled carelessly. Take time to check everyone out so these easily activated cylinders will not be accidently expended.

Make certain that every plane captain knows how to safely carry the seat type parachute over his shoulder with his hand through the grip, locking it in its pocket. (See fig. 4–161.) Carrying the seat type parachute over the shoulder protects the parachute and permits the carrier greater freedom of movement and safety.

QUIZ

1. A uniform packing procedure is employed to insure
   - a. a good packing team
   - b. a longer service life of the parachute
   - c. correct rigging of the parachute
   - d. positive and rapid opening

2. Which tool is NOT used while packing the NS3–R?
   - a. Long bar
   - b. Suspension line hook
   - c. Temporary locking pin
   - d. Awl

3. Which parachute requires the use of bridge pliers to aid in closing the container?
   - a. NB3–R
   - b. NB4–R
   - c. NS3–R
   - d. NC3–R

4. Which is the most popular size sail needle used in rigging?
   - a. 12
   - b. 14
   - c. 18
   - d. 22

5. Which type hand sewing needle can take the hardest treatment?
   - a. Sharps
   - b. Sail needles
   - c. Betweens
   - d. Crewel

6. Which of the following is good dry locker procedure?
   - a. Perform any repairs while the parachute is suspended
   - b. Open all doors in the dry locker
   - c. Hang wet canopies in one corner
   - d. Keep the canopy and lines off the deck

7. Which is a fundamental step in packing?
   - a. Suspend the canopy for airing
   - b. Rigging the ripcord housing
   - c. Safety tie the locking device
   - d. Try the parachute on for proper fit

8. A recorded, visual, external inspection of the parachute in service is required every
   a. 10 days
   b. 15 days
   c. 30 days
   d. 60 days

9. To shorten the suspension lines for the dry locker, you would
   a. knot the lines
   b. chain the lines
   c. tie up the lines
   d. leave the lines in the hesitator loops

10. Which packing step immediately follows the whipping and folding of the canopy?
    a. Place canopy on pack
    b. Stow suspension lines
    c. Sign inside Parachute Record Card
    d. Insert the pilot chute

11. What parachute part receives the least amount of wear?
    a. Harness
    b. Canopy
    c. Pilot chute
    d. Container

12. When whipping and folding the 28-foot canopy, which gore is folded to the packer's side?
    a. No. 26
    b. No. 14
    c. Top center
    d. Bottom center

13. When packing, how much free suspension line should be left between the skirt hem and the last hesitator loop?
    a. None
    b. 6 to 12 inches
    c. 12 to 18 inches
    d. 18 to 22 inches

14. Too much free line left between the skirt hem and the hesitator loop could cause
    a. line twists
    b. line dips
    c. line overs
    d. line burns

15. The long bar is used to
    a. position corner flaps
    b. position lift web protector flaps
    c. aid in inserting ripcord pins
    d. fold the canopy on the container

16. When packing the NC3–R, which is the short fold?
    a. First
    b. Second
    c. Middle
    d. Last

17. When packing the NC3–R, which side of the container is first brought up over the canopy?
    a. Ripcord end
    b. Opposite the ripcord end
    c. Cone side
    d. Grommet side

18. What thread is used for the safety tie of the ripcord pin?
    a. 24 x 4 cotton
    b. 16 x 4 cotton
    c. "A" nylon
    d. "B" nylon

19. The pocket on the NC3–R cross connector strap contains the
    a. Parachute History Card
    b. Parachute Record Card
    c. Striking Data Record
    d. Emergency Signal Code

20. When positioning the chest snap for tacking, the distance from the shoulder adapters should be
    a. 3–4 inches
    b. 4–8 inches
    c. 6–8 inches
    d. 6–12 inches

21. What type thread is used to tack the chest snap?
    a. "FF" nylon
    b. "E" nylon
    c. 6-cord cotton
    d. 6-cord nylon

22. What should be done with the extra lengths of the adjusting harness straps?
    a. Cut off excess
    b. Tie the loose ends together
    c. Leave the loose ends free
    d. Tuck the loose ends under the harness

23. The earlier type quick connector link screws are tightened to a maximum torque of

    a. 18 pounds
    b. 22 pounds
    c. 25 pounds
    d. 30 pounds

24. The raft retainer strap is tacked to the pack keeper in four places with

    a. 1 turn, 6-cord nylon, single
    b. 2 turns, 6-cord nylon, single
    c. 1 turn, 6-cord nylon, double
    d. 2 turns, 6-cord nylon, double

25. On the NS3–R, how much folded canopy should extend over the sides of the pack?

    a. Even with the pack edges
    b. 1–2 inches
    c. 2–4 inches
    d. 3–4 inches

26. On the NS3–R, to test the ripcord assembly location, it is subjected to a maximum pull of

    a. 20 pounds
    b. 25 pounds
    c. 30 pounds
    d. 50 pounds

27. On the NB3–R, beginning at the ripcord housing, which pin is safety tied?

    a. 1st
    b. 2nd
    c. 3rd
    d. 4th

28. How many gores are incorporated in the canopy of the NB4–R parachute?

    a. 22
    b. 24
    c. 26
    d. 28

29. How is the ripcord housing tacked to the NB4–R pack?

    a. 1 turn, 3-cord nylon, double
    b. 2 turns, 3-cord nylon, double
    c. 3 turns, 3-cord nylon, double
    d. 2 turns, 6-cord nylon, double

30. On the NB4–R, how many inches above the machine stitching should the lift web be tacked to the pack support straps?

   a. 1 inch
   b. 3 inches
   c. 4 inches
   d. 6 inches

31. What packing tools are carried with the NB4–R pack?

   a. Pull-up lines and key
   b. Key and hook
   c. Slider and key
   d. Pliers and slider

32. Which would cause the least damage to a service parachute?

   a. Carrying by the lift webs
   b. Placed near a source of heat
   c. Dropping
   d. Letting the parachute get wet

33. Which main part of the parachute should be placed into the bottom of the chafing bag?

   a. Canopy
   b. Pilot chute
   c. Suspension lines
   d. Harness

34. What is the recommended method of carrying the NS3–R parachute?

   a. Leg strap over the shoulder
   b. Pack on the shoulder
   c. Main sling over the shoulder
   d. By the raft case web handle

CHAPTER 5

JUMPING TECHNIQUES AND THE ELEMENTS

THE ATMOSPHERE

As one ascends into the atmosphere, it becomes colder and less dense. The atmosphere is denser when the weather is cold and damp, and thinner when it is hot and dry. This is due to a reduction of atmospheric pressure, and must be considered in relation to resistance. An object or a human body will fall faster at higher altitudes. Therefore, it must be understood that the speed established by the terminal velocity of a free-falling body varies depending on the altitude and density of the atmosphere. At an atmospheric pressure of sea level, the vertical descent or terminal velocity of a free-falling body is approximately 120 miles per hour. This speed will vary depending on the temperature and humidity and the looseness of the clothing a jumper is wearing.

The rate of descent of a fully opened parachute is less and the opening shock is greater when the percentage of humidity is relatively high, this being due to the accompanying density of the atmosphere. Hot and dry atmospheric conditions will cause the reverse and will result in less opening shock to the jumper and a greater rate of descent.

HOW THE PARACHUTE FUNCTIONS

We already understand the mechanical functioning of the parachute. Now, let's consider the relationship between the design, the material, and the atmosphere. A parachute is designed to take advantage of air resistance. In order to guarantee a safe rate of descent, the canopy must be designed with a very large area of cloth. In order for the assembly to be successful, the cloth must be capable of withstanding great amounts of stress and must possess elasticity.

When the ripcord is pulled the pilot chute springs from the pack and hastens the opening time of the main canopy and suspension lines by acting as a drogue and holding the peak relatively stationary as the jumper falls away from it. In a normal deployment there are two forces transmitted to the jumper. The first is called SNATCH FORCE, and occurs at the moment of full line stretch when the free-falling body overcomes the inertia of the parachute previously started by the pilot chute. The second force is called INFLATION FORCE, and is caused by the air entering the canopy which at this instant is subjected to the full resistance of the airmass. These opening forces are commonly referred to as the OPENING SHOCK. The standard parachutes used in the Navy are designed to withstand opening shocks of approximately 8,000 pounds. This is the average figure sustained at approximately 300 miles per hour, while drop testing with a dummy weighing 250 pounds. However, most canopies will stand greater strains than 8,000 pounds.

The rate of descent is controlled by temperature and humidity; size and design of the canopy, and material used; and weight of the load.

The size and design of the canopy, and the material used, are the determining factors of the rate of descent of any parachute. The standard parachutes adopted by the Navy are the 28-foot flat type and the 26-foot 22-gore conical. The 26-foot 22-gore type is designed to provide a lightweight, low-bulk pack. Ripstop, nylon cloth (type I) is a strong, specially woven material capable of providing the necessary strength and porosity needed for a safe descent.

A fully opened parachute actually breathes as it descends through the air. This breathing action is caused by air pressure building up inside the dome-shaped canopy and expelling itself around the edges. Air also passes directly through the weave of the cloth and through the vent of the standard 28-foot type canopies.

Oscillation is not desirable in a parachute. This swaying motion can be dangerous to the jumper in making a landing. Oscillations can be controlled to a certain extent; and the best way to control them is to build a more stable canopy such as the 26-foot 22-gore conical type.

BAILING OUT AT HIGH SPEEDS

Impact with the airstream and deceleration are two very important factors now being studied in relation to bailing out at high speeds. In the case of 500 m. p. h. jets, a pilot would not be able to go over the side unaided by a mechanical device, and use his parachute. Impact with the airstream could injure the unprotected human body. Research has proven this and a very successful device has been developed for catapulting a man clear of the aircraft. This human catapult is called an EJECTION SEAT. The purpose of the seat is twofold. First, it fires (explosive charge) a man free of the aircraft; and second, it protects him from the airstream while slowing down to a safe speed before using his parachute.

The speed of the aircraft and the altitude at the time of bail out are determining factors in the length of time a man can safely wait to use his parachute.

Ejection seats are installed in all jet aircraft. Be familiar with the necessary safety precautions to avoid accidently firing the mechanism. All aviation rates should be thoroughly instructed on the dangers involved in working in the cockpit around an ejection seat assembly. The firing and safety mechanisms vary with the aircraft. Be sure to check on the type your squadron uses before climbing into the cockpit. Mobile Training units are presently engaged in training aviation personnel in the use of the ejection seat.

Bail-Out Cylinder

The bail-out cylinder has been previously described in chapter 4 under the rigging procedures of the seat type parachute. It is important to connect the oxygen mask with the source of the emergency oxygen supply (approximately 10 minutes). This connection is a bayonet type fitting. The fair-lead of the connecting tubing should be safeguarded to insure a smooth and easy escape from the cockpit. The limited supply of oxygen cannot be wasted. The aircraft system should be used up to the last minute before bailing out. A force of 20 pounds in a straight-up direction exerted on the ball handle is needed to actuate the mechanism. When the ball is pulled, the cable will not disengage from the cylinder as a parachute ripcord does, but will remain attached after operation.

When the bail-out unit is used as an emergency oxygen supply, the user will place it in operation by pulling the ball handle immediately after noting failure of the aircraft oxygen system. A lower altitude, where a normal oxygen ratio exists, must then be reached before the emergency supply is exhausted.

Inasmuch as this equipment is for emergency use, the user should take every precaution to be assured that the bail-out unit is in the best possible working condition. Part of your job as a Parachute Rigger is to make sure that this equipment remains in good working condition and is properly rigged to the parachute, maintains its proper charge, and that everyone using this equipment is properly instructed in its use. It is the duty of the Parachute Officer to schedule a training program that will adequately meet the needs of a squadron or unit.

Bail-Out Procedure Without Special Oxygen Equipment

In a low pressure chamber, at a simulated altitude of 25,000 feet, sitting quietly, breathing atmospheric air, one can remain conscious but not alert from 4 to 6 minutes; at 28,000 feet, from 2 to 3 minutes; and at 30,000 feet, from 1 to 2 minutes. The physical exertion and excitement involved in bailing out at these altitudes will reduce these time intervals to less than one-third of this time. It is essential that one make all preparations possible for escape while breathing oxygen and prior to disconnecting from the oxygen systems. A safe descent can be made from altitudes below 35,000 feet without the use of bail-out oxygen equipment, if the proper technique is followed.

The necessary procedures for abandoning an aircraft safely from altitudes in excess of 22,000 feet cannot afford to be clouded by poor judgment brought about by the result of lack of oxygen (hypoxia). When the order "abandon plane" is given, a previously drilled procedure of escape should be followed which includes breathing oxygen until just before leaving the plane.

In all cases of abandoning airplanes at high altitudes, just before leaving and before disconnecting from the oxygen supply, take one or two deep breaths of oxygen. From this point on, holding the breath is the only adequate protection against the lack of oxygen.

The following technique is recommended on all jumps above 22,000 feet:

INHALE OXYGEN. Take one or two full breaths, but do not expand the chest to the point of discomfort.

At the peak of inspiration CLOSE THE LIPS and HOLD YOUR BREATH.

Build up pressure by attempting to exhale but at the same time holding the breath (GRUNT BREATHING). This closes a small throat valve that will hold the air in the lungs and force more air into lung spaces that would not normally receive air, thereby enriching the blood with this added amount of oxygen. If this is done correctly, the abdominal muscles will contract and become hard.

LEAVE THE AIRPLANE AS QUICKLY AS POSSIBLE. DO NOT MAKE UNNECESSARY MOVEMENTS.

MAKE A FREE FALL. Due to the physical exertion and excitement, the urge to breathe may become very strong in 30 to 45 seconds. This urge can be eased by swallowing or breathing out half the air in your lungs, which will allow you to hold the remaining air about 20 seconds longer.

When bailing out of aircraft at high altitudes, a free fall has the following additional advantages:

1. Eliminates the danger of pulling the ripcord too soon and getting the parachute fouled in the aircraft.
2. Forward motion imparted by the aircraft has ceased and avoids dangerous stress on the parachute when it opens.
3. The terminal velocity decreases with decreasing altitude due to the increase in density of the air. This also decreases the stress on the parachute when it opens.
4. Decreases the time exposed to freezing temperatures.
5. Strafing from enemy aircraft is lessened.

The pilot or aircrewman must use the proper technique as described above, otherwise he will "pass out." Attention is also called to the fact that if the jumper does not use a long enough free fall and opens his parachute at rarefied altitudes, he can practice a forced method of breathing (grunt breathing) which builds up additional air pressure in the lungs. The additional pressure gained through "grunt breathing" forces the small amount of oxygen in the rarefied atmosphere into the blood stream. The method employed in "grunt breathing" was previously described.

Figure 5–1 illustrates the comparative rates of descent from 30,000 feet.

Future Rigs for Bailing Out at Great Altitudes

The Navy has developed a pressure suit which is designed to inflate with air at the moment the cockpit or cabin pressure is lost at high altitudes. The pressure suit will have to be individually fitted with great care and skill. The human body is accustomed to a surrounding atmospheric pressure of approximately 14.7 p. s. i. at sea level and can withstand varying pressures of considerable magnitude providing they are applied gradually. Lessening or increasing the atmospheric pressure, suddenly and in great amounts, can cause death in a fraction of a second. The pressure suit is designed as an emergency measure and is uncomfortable to wear when subject to pressure. As a result of this, a person's mobility is reduced to the point where it is necessary

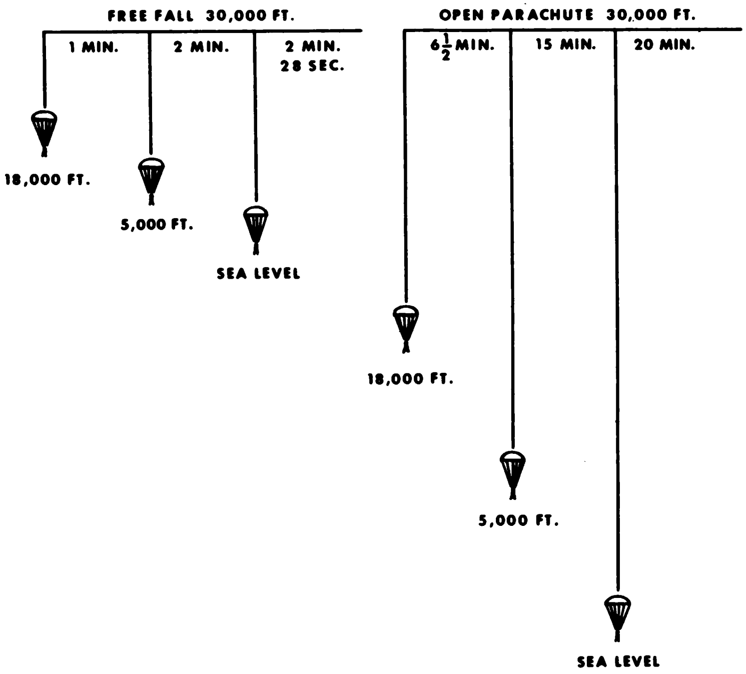


Figure 5–1.—Comparative rates of descent.

to descend to a normal atmospheric level before he is able to move about in a normal manner.

THE JUMP

The parachute is an indispensable lifesaving device. The parachute, unlike a safety belt or a life raft does not allow the user to fall back on other means of survival such as swimming or bracing one's self. The man about to embark on a parachute jumping adventure must have absolute confidence in his equipment if he expects to go through with the jump. Doubt is a poisonous thing. That is the reason one premeditated free-fall parachute descent is required before becoming qualified for Parachute Rigging duties. You must be thoroughly conversant with all aspects of the subject. Parachute Rigging is unique in this respect as no other rating demands a more exacting graduation and display of confidence. This is not a show but a lesson; the kind of lesson that can only be implanted by individual participation. After you have made the graduation parachute jump, you will feel as though you are fully qualified to carry out this high type of survival work.

Jumping From an R4D Under Standard Conditions

The trainee attending the Parachute Rigger School will be instructed many times on the technique of making his graduation jump. Every possible condition of the descent will be discussed so that the novice will be thoroughly acquainted with this approved jump procedure.

Everyone is given a physical examination prior to making the jump. In addition to the instructions about the jump, the trainee is given an extensive period of physical training to prepare his body for the day he will jump out of the aircraft at a speed of approximately 100 m. p. h. The altitude will be 2,000 feet. That's a long step, but an easy one for the properly trained and conditioned candidate. Many trainees plead for permission to make the second jump immediately after landing on the first. Their attitude is gratifying as this is the kind of confidence desired.

The instructors that jump with the trainees are qualified or qualifying Naval Parachutists. The men who have earned the Parachutist Wings were required by regulations to make a minimum of six premeditated free-fall parachute descents while in a student parachutist status. After the final qualifying jump the student parachutist is designated a Naval Parachutist for the remainder of his tour of duty at the jumping activity. This designation is signed by his Commanding Officer and will remain in effect as long as the man continues to jump. This is in accordance with certain regulations promulgated by the Bureau of Naval Personnel. The Naval Parachutist may wear the Jump Wings associated with the designation.

A review of a training parachute jump follows:

1. After the trainee has donned his training assembly

back and chest parachutes, he is given two thorough inspections by two qualified Naval Parachutists, who make certain that all equipment is rigged properly.

2. The trainee is again briefed concerning the jump procedure.

3. The men enter the aircraft in a reverse order of the jump so that number one man and the spotter will be nearest the point of exit.

4. All men sit down, fasten their safety belts, and await takeoff.

5. Trainees should relax, and remember their training; the rest will be automatic.

6. As the aircraft approaches the jump area, the jumpmaster will inform the pilot of any course corrections necessary to fly over the predetermined drop point. At that time he will put out a spot jumper. The impact point of the spot jumper will determine the accuracy of the drop and corrections in course and drop point.

When the correct drop point is ascertained, the training run will be made. On a signal from the jumpmaster, jumpers will stand up and face the exit. The next signal from the jumpmaster will be STANDBY. This signal is given two or three seconds prior to the signal to Go. Jumpers will then leave the aircraft as rapidly as possible.

7. There is no danger of the jumper's body hitting the tail section. There IS danger of the chute passing over or catching on the tail. The body attitude is not critical although the feet are kept together upon leaving the aircraft.

8. The count is "1 and 2 and pull." The COUNT is established to get the jumper clear of the aircraft and prevent premature opening. It standardizes the distance of the free fall. The training free fall is generally standardized at 3 seconds before the ripcord is pulled.

The ripcord grip is pulled with the right hand after the jumper has completed his count of "1 and 2 and pull." The PULL is made sharply out and down to the right knee, after which the hands and arms are folded over the chest.

9. Wait for the opening shock. The opening shock will

take place within less than 3 seconds. To some this is the longest 2 or 3 seconds in their lives. Others aren't conscious of the elapsed time between the pull and the opening shock. It is the latter group that we are most concerned about, and that is one reason why we emphasize pulling the ripcord sharply out and down to the right knee. Also, the entire length of the ripcord must be withdrawn from the housing, evidenced by the entire ripcord being visible to the jumper. This is accomplished in a split second and should not in any way hamper the return of your right arm to the in-body position. If this action and timing is followed, the parachute will most certainly be released. If you have the urge to make a long free fall, disregard it and remember your training count. People on the ground are counting on you, and the director is anxiously awaiting to count the "stick of jumpers" with billowing white canopies to show that they have all successfully passed the second stage of their descent.

10. After the opening shock, check the canopy for malfunctions. If conditions are normal, secure your ripcord under one of the lower pack opening bands of the chest parachute.

On very rare occasions malfunctions may occur. These consist of torn fabric or a suspension line or lines passing over the inflated canopy. These lines might stubbornly cling to the top of the inflated canopy, dividing the projected diameter to only a fraction of its original area. This condition, depending on how bad it is, can greatly increase the rate of descent. If the canopy is subjected to this type of malfunction, it can be cleared in most instances. When satisfied that your rate of descent is not excessive, time may be taken in an attempt to clear the line. Grasp the line, or lines, in question and work them off the top of the canopy by pulling down on them for a short distance and releasing them from this position. This may help them to slide off and reestablish the full projected diameter. Sometimes the lines clear themselves. In any case they should be cleared, and in the event that they cannot, the chest parachute should be used to supplement the loss of the projected diameter of the main canopy. The director on the ground may order you, through the use of a power megaphone, to come in as you are (with a line over), if he can positively judge your descent as not being excessive. In the event you are ordered to use the chest parachute, and your rate of descent is not excessive, an attempt should be made to determine the wind direction and to deploy the canopy downwind. This affords a more positive and rapid inflation. If the rate of descent is excessive, wind direction is not important since airflow generated by the falling speed will dominate the parachute action.

After pulling the ripcord and no opening shock is experienced within a few seconds, there is a probable malfunction. The beginner should not take the time to analyze the condition beyond the fact that the parachute is not open and that the ripcord has been pulled. The chest parachute is there for emergency purposes. Do not hesitate to use it. In this case throw away the ripcord in order to free your hands for action. Pull the chest parachute's ripcord while holding the sides of the chest pack closed with the left hand. Get rid of the second ripcord. Now let the sides draw back out of the way while pressing the canopy to the pack. Grasp the canopy and throw it out and away from you.

A torn parachute is not necessarily unsafe. For one thing, the rate of descent can be slower due to air turbulence being set up over the canopy. This turbulence is caused by the air passing through the rents in the cloth. Too many holes, or too large a hole, will add to the rate of descent. This condition should be treated with caution since the tears can become larger at any time and transform the condition into a hazardous experience.

11. Controlling the parachute by manipulating the suspension lines is not a recommended practice for the novice. Manipulation of the lines often causes oscillation which can be dangerous when landing.

Pulling down on the suspension lines causes the air to spill out of the opposite side of the canopy. This action provides a slipping motion of the canopy and jumper through the air in the same direction as the group of lines pulled. In other words, pull down on the right side and you will slip to the right.

12. Prepare for landing. Grasp the front lift webs with both hands at about head level. Place feet together and slightly bend the knees. Do not land on heels. Make every effort to control yourself and relax. Maintain enough muscle control for a well-executed tumble. You've learned all about the basic tumbling exercises in prejump training. Now is the time to remember and execute that training.

Jumping Procedures Under Emergency Conditions

During World War II over 5,000,000 parachute jumps were made, including troop jumps. Procedures for bailing out of troop carriers were well planned. The question of how to get out of a crippled fighter or attack plane was the subject of many discussions.

Emergency escape procedures, especially those involving bailing out, are extremely controversial, in nature. Many a pilot owes his life to the fact that he didn't follow a predetermined escape procedure. However, that doesn't mean that an approved method would have failed. No two situations are alike in every detail. A man about to make a decision in favor of bailing out must keep his wits and remember his training. That training must then be applied as the conditions of the emergency dictate.

Past experience with emergency bail-out actions involving hundreds of men flying in all kinds of aircraft has contributed a wealth of knowledge to the records of aviation survival. From these records the following basic rules for bailing out under all conditions have been formulated:

1. Disconnect all electric wires, tubes, etc. from your flight equipment before attempting to bail out. If necessary, actuate the oxygen bail-out supply.
2. Do not attempt to stand erect in the plane and extend into the slipstream before launching the body out of the cockpit. When not equipped with the ejection seat, jump out of the aircraft in a crouching position, stay-

ing close to the fuselage. Do not hold the ripcord but grasp the webbing over it to guard against a premature opening.

3. The universal rule for bailing out is, GET CLEAR OF THE AIRCRAFT, THEN PULL THE RIPCORD.

Emergency escape procedures have been formulated for every type of naval aircraft to familiarize airmen with the best methods and escape paths to follow. These procedures clearly show the location of each man's station in relation to the location of his parachute (chest type) and the shortest path of exit. Information relative to an emergency nature can be found in the *Flight Handbook* of any given type of aircraft. The Parachute Rigger should take steps to study the escape procedures for his particular squadron or unit, so that he can be better informed on the subject.

Figures 5–2 and 5–3 illustrate two drawings of the escape paths or procedures for multiengine patrol and fighter type aircraft.

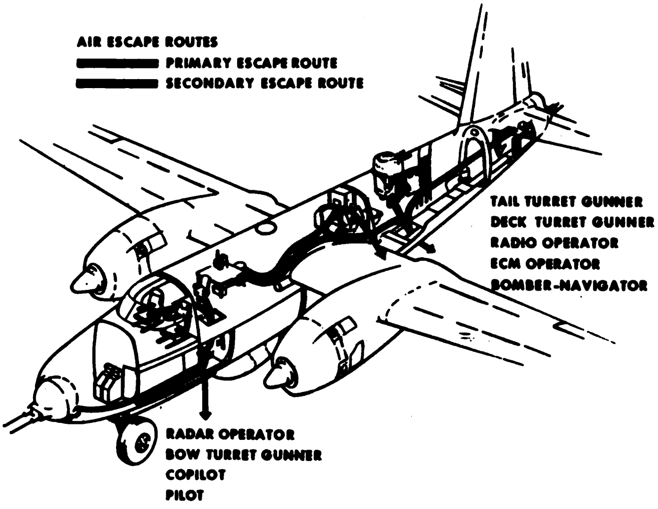


Figure 5–2.—Emergency escape procedures for a patrol type aircraft.

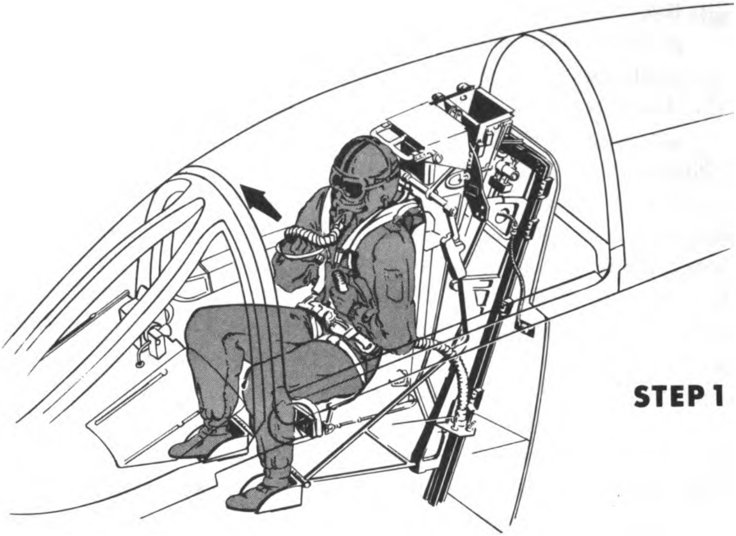


Figure 5–3.—Emergency escape procedure for a fighter type aircraft. Step 1. Preparing for bail out.

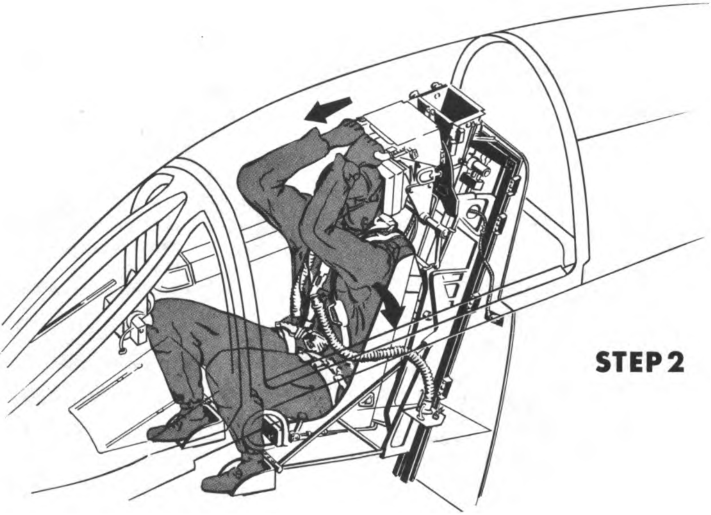


Figure 5–3.—Emergency escape procedure for a fighter type aircraft. Step 2. Preparing for bail out.

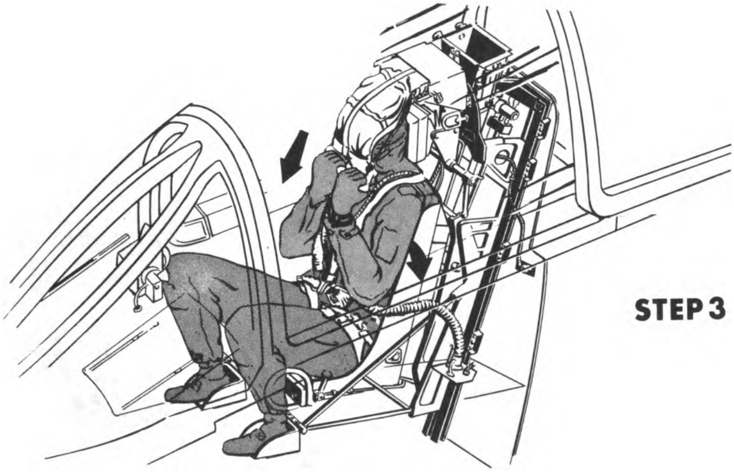


Figure 5–3.—Emergency escape procedure for a fighter type aircraft. Step 3. Pulling face curtain down.

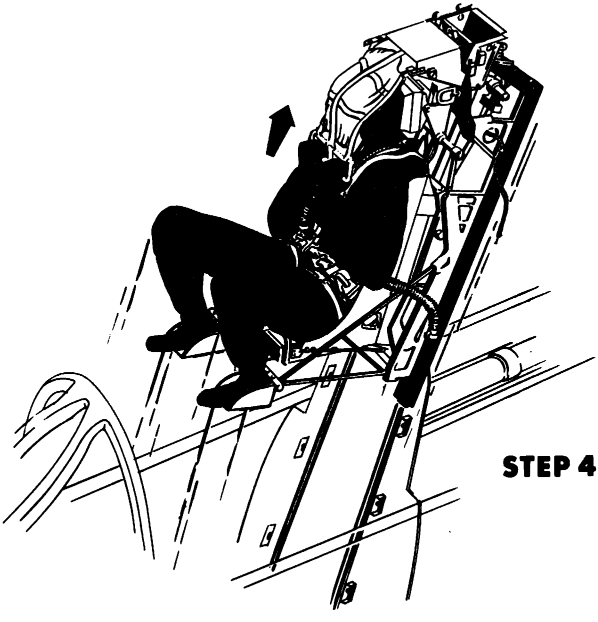


Figure 5–3.—Emergency escape procedure for a fighter type aircraft. Step 4. Explosive charge ejects pilot and seat.

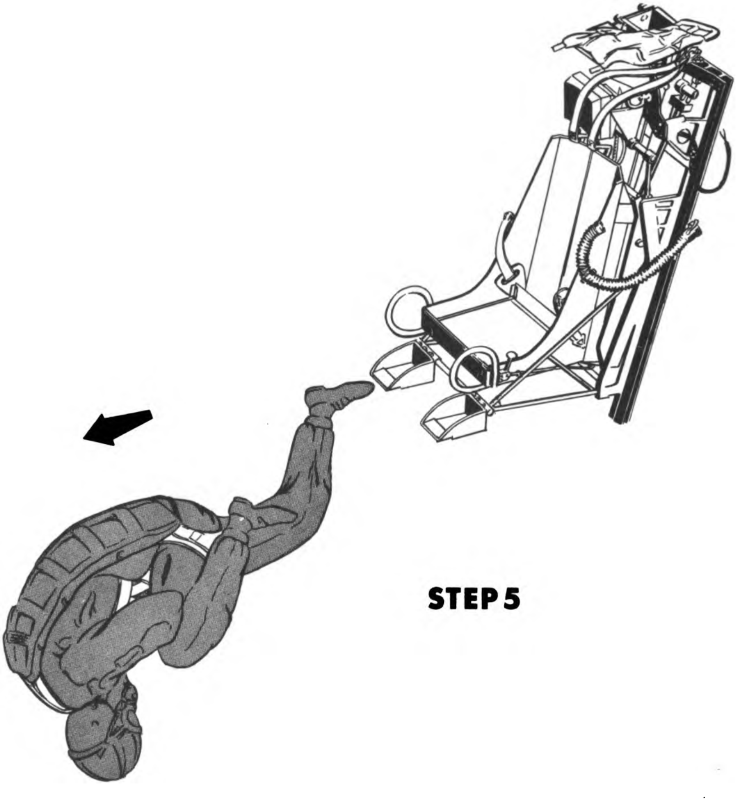


Figure 5–3.—Emergency escape procedure for a fighter type aircraft. Step 5. Separation of seat from pilot.

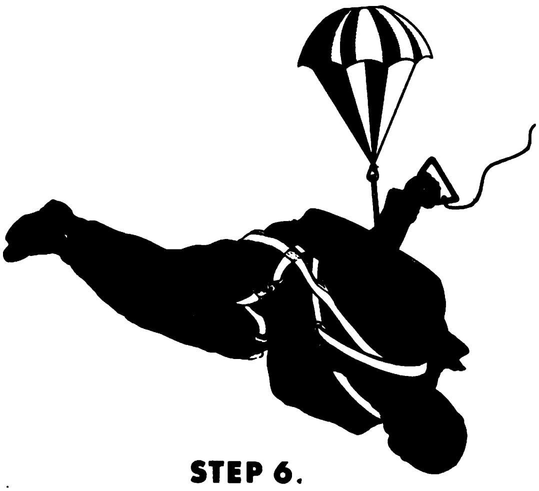


Figure 5–3.—Emergency escape procedure for a fighter type aircraft.
Step 6. Manually releasing the parachute.

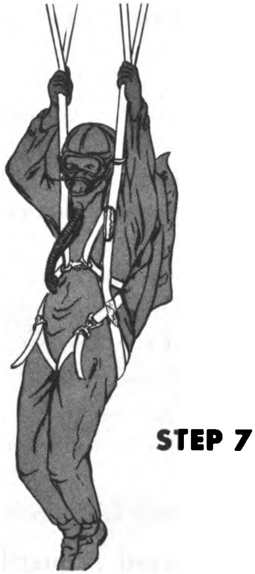


Figure 5–3.—Emergency escape procedure for a fighter type aircraft.
Step 7. Assuming landing position.

EMERGENCY BAIL-OUT CONSOLE

As a result of experiments, the Navy has procured a number of consoles or connectors to eliminate the multiplicity of wires and tubes connecting the pilot to his radio and survival gear, and in which he often becomes entangled when bailing out.

In the Bureau of Aeronautics type, all of the connections are released by one simple motion already familiar to pilots—releasing the safety belt. The following features of this type of connector over the present system in cockpits are:

1. It quickly disconnects the pilot from all of his plane connections when the safety belt is released.
2. Reduces escape time 100 percent.
3. Prevents equipment entanglements during escapes when the pilot either willfully failed to complete disconnections or did not have time to do so.
4. Centralizes connections formerly scattered throughout the cockpit, thereby making more room in the cockpit. The connector is situated at the waist level where the bulky anti-G and heating suit connections will be the shortest and out of the way. Directions for rigging the connector to the parachute harness are given in technical publications.
5. Locates pilot's connections in a comfortable out-of-the-way position reducing entanglements and annoyances in flight.
6. It is easily adaptable to the ejection seat through use of the seat release. It makes possible the use of oxygen during the first part of the descent in the ejection seat, since a valve can be placed to "cut in" a small oxygen cylinder fastened to the bottom of the seat for initial descents from very high altitudes.

HIGH WIND LANDINGS

The parachute was designed primarily to protect from a fall. Landing safely with a parachute in a high wind is not an easy task. Initial touch-down may seriously injure the jumper or make him unconscious, which would make it impossible for him to defend himself. However, proper technique is extremely helpful in reducing the chances of death or injury during high wind landings. The danger lies in the fact that a high wind is capable of blowing a jumper and his parachute along the ground, thus causing serious injury or possibly death. The jumper is responsible for deflating the canopy after landing. But a jumper may elect to unsnap his harness during the descent, and allow the harness to pull from his body after touch-down. This unsnapping may be done PROVIDING HE CAN MOVE BACK IN THE SLING OF THE HARNESS—that is, providing he can sit in the harness as though sitting in a swing, with NO weight on the leg straps. If he should unsnap the leg straps while supporting his weight on them, he is in great danger of falling from the harness. Under no circumstances should the chest snap be released before the leg snaps.

In the event he cannot safely release the leg snaps, he should elect to land with the harness fully snapped up. Since unsnapping a harness while being dragged is next to impossible, collapsing the canopy by deflating as shown in figure 5–4 should be employed. Rapid deflation can be accomplished regardless of wind velocity if the jumper re-

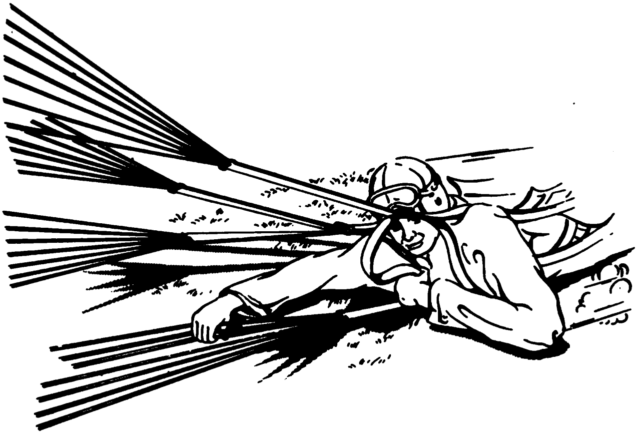


Figure 5–4.—Deflating the parachute canopy.

mains calm and applies the deflating technique with determination. Deflation on land is accomplished by pulling in on any BOTTOM suspension line or group of suspension lines.

The deflating process can burn the hands and fingers. The lines should be grasped, as illustrated in figure 5–4, with a sideward twisting motion of the hands and wrists as each new snubbing grip is made along the lines.

After the parachute has been deflated, it is a good practice to sit on the canopy while unsnapping and preparing to slide out of the harness.

LANDING IN THE WATER

Under some conditions the most desirable place to land in a parachute is in water. A jumper should prepare himself in the same manner as for a high wind landing except when equipped with the ejector snaps.

While still airborne, remove the pararaft kit from the kit container and lower slowly until the full length of the retainer strap has been released.

Depth perception over the water is wholly unreliable for accurate judgment of distances, so do not leave the harness until contact is made with the water. Upon entering the water, slip out of the harness. The body will not submerge any deeper than the head or shoulders.

Never inflate the life vest until you are in the water. If necessary, deflate the canopy by pulling in on the top suspension lines as the body is pulled through the water.

Before inflating the pararaft, release all of the snaps holding the pararaft in its case. This will prevent tearing the raft body during inflation in case one or two of the flap securing snaps jam. Inflate the pararaft by pulling on the toggle attached to the actuating lever.

If possible, hang the parachute over the bow of the pararaft. This will help to keep it stable during the boarding process. Board the pararaft from the low or aft end.

In the interest of securing everything for future use, keep the parachute and take an inventory of everything that has been saved. Further information about the pararaft and other life rafts will be discussed in volume 2 of this series.

TREE LANDING

Landing in a tree is not necessarily hazardous. Keep the feet pressed tightly together and protect the face with your arms. The top branches will snap off under the onslaught. Do not attempt to grab a branch or hang on. Wait until you have stopped falling. If you can manage to see through the open places in your folded arms, it will help in judging the landing.

The amount of swinging and various other dexterous activities that may be performed in getting down out of the tree depends on two things: First, how firmly the parachute is entangled with the branches of the tree; and second, the distance to the ground.

QUIZ

1. The human body will fall fastest at which of the following altitudes?
   a. 2,000 feet
   b. 15,000 feet
   c. 30,000 feet
   d. 43,000 feet
2. Terminal velocity indicates the speed of a falling man when
   a. he leaves the aircraft
   b. he contacts the ground
   c. the parachute is fully open
   d. he is free falling
3. The rate of descent of a fully opened parachute is less during
   a. hot weather
   b. dry atmosphere
   c. high humidity
   d. windy weather

4. Opening shock is less severe under conditions of
    a. hot weather
    b. dry atmosphere
    c. high humidity
    d. windy weather

5. A prime design requirement of a parachute canopy is that the
    a. canopy must be vented at the peak
    b. suspension lines must be longer than the projector diameter
    c. cloth must be capable of withstanding great strain
    d. suspension lines must form a network for the canopy

6. The purpose of the pilot chute is to
    a. add stability to the canopy
    b. deploy the suspension lines
    c. hasten the canopy opening
    d. pilot the fully opened canopy

7. The opening shock is the force exerted on the
    a. pilot chute ejecting from the pack
    b. canopy after full inflation
    c. suspension lines paying out of the hesitator loops
    d. jumper when the canopy inflates

8. Parachutes are designed to withstand shock loads up to
    a. 6,000 pounds
    b. 8,000 pounds
    c. 87,000 pounds
    d. 10,000 pounds

9. What type of ripstop, nylon cloth is used in canopy construction?
    a. Type I
    b. Type II
    c. Type III
    d. Type IV

10. Which of the following is not a determining factor in the rate of descent of a parachute?
    a. Size of canopy
    b. Design of canopy
    c. Material used in canopy
    d. Size of pilot chute

11. The conical canopy consists of
    a. 22 gores
    b. 26 gores
    c. 28 gores
    d. 32 gores

12. The standard 28-foot canopy consists of
    a. 22 gores
    b. 26 gores
    c. 28 gores
    d. 32 gores

13. Oscillation is most dangerous to the jumper when he
    a. contacts the ground
    b. is making a water landing
    c. bails out at high altitudes
    d. lands in high winds

14. A parachute canopy breathes during
    a. the opening shock
    b. a water landing
    c. terminal velocity
    d. the descent

15. The prime purpose of the ejection seat is to
    a. enable the pilot to bail out at high altitudes
    b. slow the jumper down to a safe opening speed
    c. enable the pilot to bail out at high speed
    d. automatically eject the pilot from the seat

16. What factor determines how long a jumper should wait before pulling the ripcord?
    a. Type of aircraft flown
    b. Body position of jumper
    c. Type of parachute worn
    d. Speed and altitude

17. The ejection seat is installed in
    a. AD aircraft
    b. F4U aircraft
    c. AV aircraft
    d. F3D aircraft

18. What is the maximum duration of the oxygen supply in a bail-out cylinder?
    a. 5 minutes
    b. 10 minutes
    c. 15 minutes
    d. 20 minutes

19. What type of fitting connects the bail-out cylinder hose to the mask hose?
    a. Flared
    b. Nipple
    c. Bayonet
    d. Flanged

20. In which case would the bail-out oxygen unit be used?
    a. Failure of oxygen system
    b. Contaminating gases present in cockpit
    c. Altitude of 20,000 feet
    d. Bail outs below 10,000 feet

21. If the proper technique is used, a man can safely bail out without the use of the bail-out oxygen equipment from the maximum altitude of
    a. 10,000 feet
    b. 25,000 feet
    c. 35,000 feet
    d. 37,000 feet

22. The recommended procedure on jumps above 22,000 feet, without emergency oxygen, is to
    a. breathe gently
    b. exhale normally
    c. grunt breathe
    d. breathe rapidly

23. The disadvantage of a free fall when bailing out at high altitudes is that
    a. the jumper may fail to pull the ripcord
    b. it eliminates pulling the ripcord too soon
    c. it allows the terminal velocity to decrease
    d. strafing from enemy aircraft is eliminated

24. What is the recognized minimum premeditated free-fall parachute jump altitude?
    a. 1,000 feet
    b. 2,000 feet
    c. 3,000 feet
    d. 3,700 feet

25. Who gives the command Go for the jumpers to leave the aircraft?
    a. Training Officer
    b. Class chief
    c. Jumpmaster
    d. Pilot of aircraft

26. During a training jump and before pulling the ripcord (after leaving the aircraft), the jumper would
    a. count "1 and 2 and pull"
    b. count "1 and 2 and 3 and pull"
    c. count "1,001, 1,002, 1,003 and pull"
    d. pull at will

27. After the opening shock the jumper should first
    a. dampen out the oscillation
    b. sit well back in the seat sling
    c. turn the canopy to allow the jumper to face the direction of drift
    d. check the canopy for malfunction

28. A line over is the term used when the suspension lines
    a. have dips
    b. are twisted
    c. pass over the inflated canopy
    d. are broken

29. Which factor would cause the greatest rate of descent?
    a. Slipping the canopy
    b. Oscillation of the canopy
    c. A torn panel in the canopy
    d. A broken vent ring

30. In a parachute landing the jumper must land
    a. with the feet well apart
    b. with the feet together
    c. on the heels
    d. with the legs stiff

31. The escape procedure for a particular type of aircraft can be found in
    a. The *Parachute Manual*
    b. The *Flight Handbook*
    c. Flight Safety Bulletins
    d. Technical Orders

32. In a water landing the jumper would inflate his life vest
    a. upon entry into the water
    b. before entry into the water
    c. after entry into the water
    d. after the leg straps are unsnapped

33. A pararaft should be boarded from the
    a. port side
    b. starboard side
    c. bow
    d. stern

CHAPTER 6

PARACHUTE LOFT

The parachute loft is the servicing depot for parachutes and other related lifesaving equipment. The term LOFT is probably a misnomer, as the only lofty part of the structure is the tower where the parachutes are aired and dried. Lofts are located in various places aboard air stations. The frequency with which lifesaving equipment is handled between operating squadrons and the flight line practically dictates that the parachute loft be located on a ground level and in the vicinity of the hangars. However, such is not always the case as lofts are often far removed from the line.

The naval air station parachute loft should be located close to the hangar from which the aircraft operate. A FASRon parachute loft should be centrally located near the line and equally accessible to all squadrons. These recommendations are especially important as the Parachute Rigger also has the responsibility of servicing aircraft oxygen systems.

LOFT FLOOR PLAN

Parachute Loft Ashore

Figure 6–1 illustrates an ideal floor plan for a parachute loft. Design varies from station to station depending upon the mission of the station.

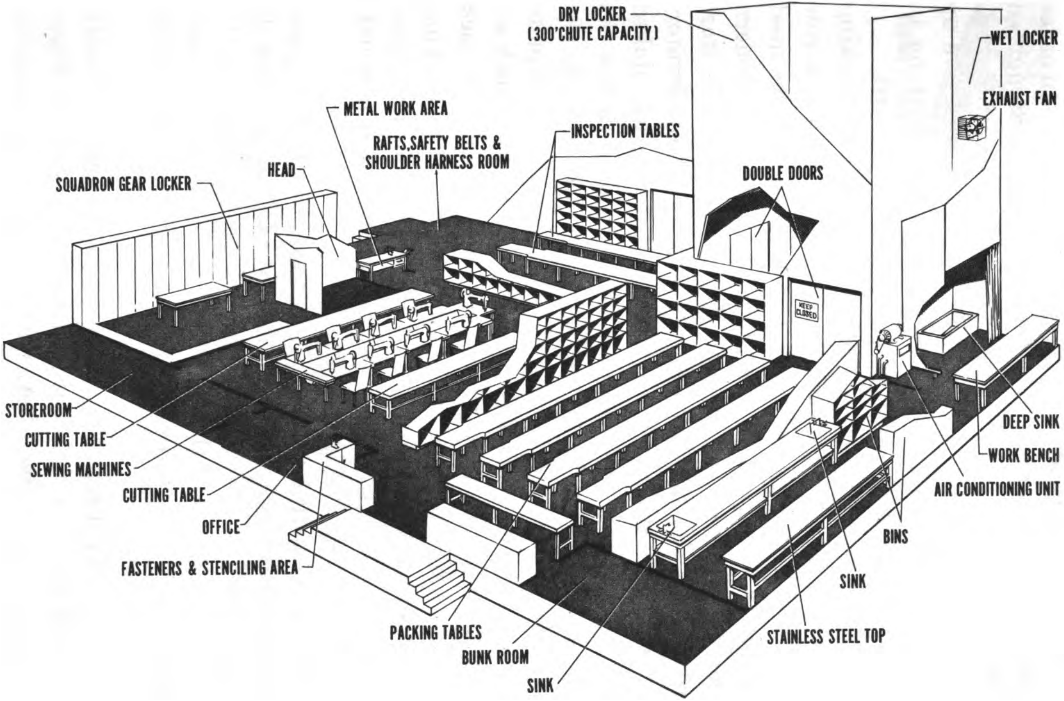


Figure 6–1.—Floor plan for a parachute loft.

CVA FACILITIES.—The CVA loft, like most all maintenance shops afloat, is extremely limited in size and scope. In order to accomplish the vast amount of work that flows through an establishment of this kind everybody must cooperate by adhering to a well-planned schedule. Everyone must live up to the phrase: "A place for everything and everything in its place," if any semblance of order is to be enjoyed.

The physical layout of the space provided for packing parachutes is made up of three main things: A table, a row of bins, and a sewing machine. Realizing the serious need for properly airing and drying parachutes, the more modern carrier has provided an enclosed drying space on the starboard side of the hangar deck, by number three elevator. The need and justification for this drying space was linked to the need for an adequate packing schedule. Before the added space for drying parachutes was incorporated, the parachutes due to to be packed were hung in the inadequate loft space. This jammed the packing schedule to such an extent that the air group squadrons were unable to pack their parachutes during the allotted time. (The packing interval is now 60 days.) A dry locker affords the opportunity to clear the parachutes out of the loft where a round-the-clock packing schedule is possible.

Figure 6–2 illustrates the physical layout of a typical parachute loft space located on the 02 deck of a CVA type aircraft carrier. The loft space and adjoining passageways are the responsibility of one of the ship's "V" divisions. Air groups using this space are required to help in its maintenance while they are aboard.

CVE AND CVL FACILITIES.—The parachute packing facilities aboard this type vessel are extremely limited. A Parachute Rigger has three alternatives to meet the packing schedule: One, he can pack on messhall tables; two, he can make a lightweight plywood, sectional packing table that can be set up temporarily in a clear part of the ship; and three,

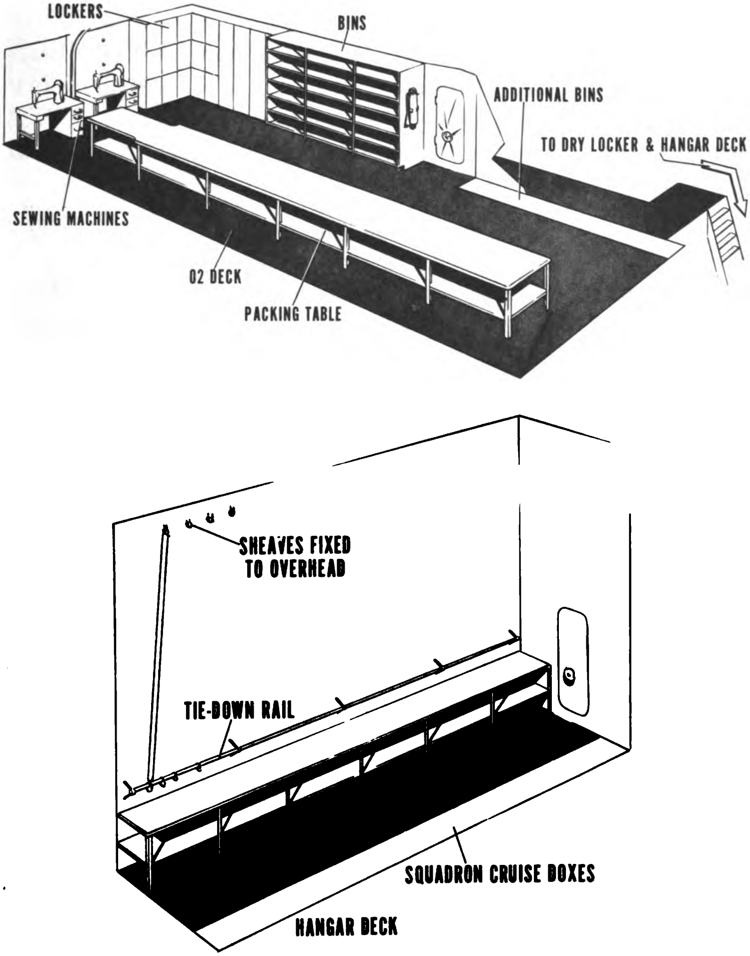


Figure 6–2.—Parachute loft space aboard an aircraft carrier.

he can use the shore establishments packing facilities whenever possible.

Parachutes are stowed in lockers distributed throughout the ship. There is no assigned working space large enough to carry out the everyday working schedule. The duty aboard a CVE may be classified as a "field operation" that will demand more of the Parachute Rigger's ingenuity than can be related here.

AV AND AVP FACILITIES.—The parachute loft facilities aboard an AV may be compared to the CVA since there is a packing space provided in the design of the ship. AVP's are extremely limited in accommodations, even more so than the CVE.

Parachute Packing Section

The packing section is devoted to packing and to inspecting parachutes. Quite naturally, the parachute packing tables occupy the greatest part of this section.

STORAGE BINS.—Storage bins and lockers serve an obvious purpose. Figure 6–3 illustrates the proper method of storing a seat type parachute rigged with a pararaft kit in a storage bin. Note that there is enough clearance between the shelves and sides to allow for easy insertion and removal of the parachute. In order to properly accommodate all types of parachutes a rectangular storage bin is necessary. The bin should be constructed long enough so that the parachutes can be placed on a shelf side by side with at least one inch clearance on all sides, and on top. The bottom row of the bins should be located about 12 inches from the deck and 4 inches away from the bulkhead.

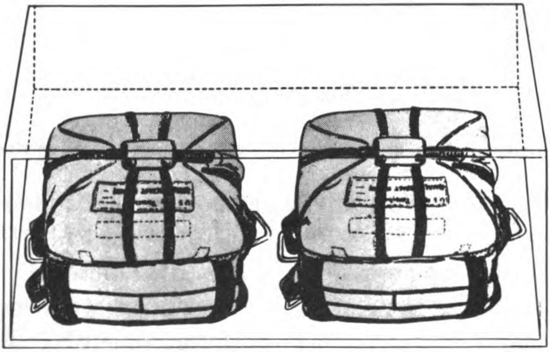


Figure 6–3.—Storing parachutes in bins.

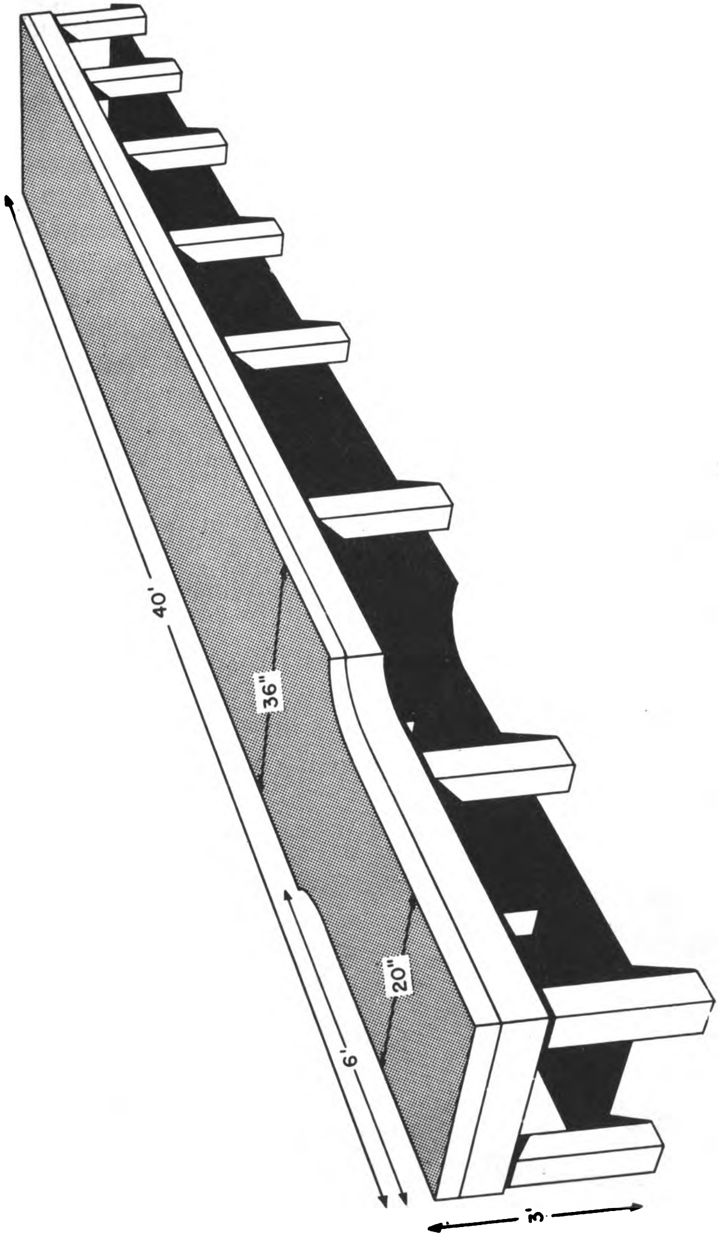


Figure 6-4.—Cutaway packing table.

LIGHTING.—Lighting a loft is very important. It takes good eyes and good lighting to spot irregularities of stitching in glossy, white material. Lighting should be as flat as possible (without shadows) and bright enough to give an inspecting team every possible chance to detect any defects in the item under inspection. For this purpose fluorescent lighting has been found to be best.

IDEAL LOCATION AND ARRANGEMENT OF PACKING TABLES.—The parachute packing section of a large activity is ideally located where it is segregated from the common loft traffic. Packing operations are not to be interrupted, and this area should be kept orderly. Tables spaced 3 feet apart and parallel to each other provide the best arrangement. More room is needed at the foot of the tables than at the heads where very little activity takes place. Smaller and wider tables placed at the ends of the packing tables serve as finishing-off areas for parachutes packed under mass production methods.

PARACHUTE PACKING TABLE.—Figure 6–4 illustrates the cutaway style packing table.

The cutaway table model is the least tiring to use, since the packers do not have to stretch across its full width during final stages of packing. Figure 6–5 illustrates three of the most commonly used rigs for tensioning the parachute on the table.

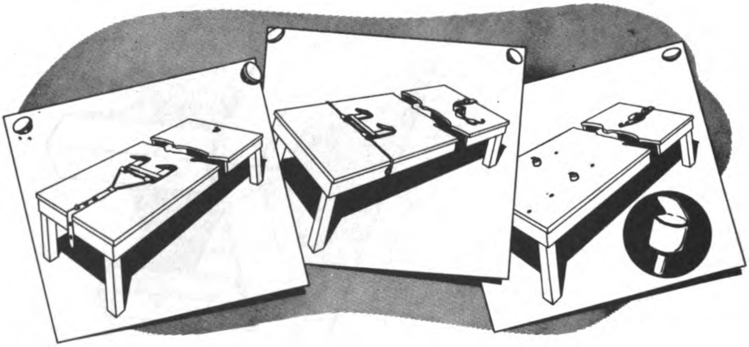


Figure 6–5.—Packing table attachments.

The tensioning device is extremely simple to make. Figure 6–6 illustrates the spreader bar, bungee, and pack extension.

Workload.—A reasonable maximum workload per day, per table, is considered by many to be about 25 parachutes. For example, consider an air station designed to handle five air groups plus its own aircraft and a FASRon. The five air groups use approximately 750 parachutes. This figure is conservative, and will vary, depending on the number of aircraft assigned. The parachutes are due for repacking at least once every 60 days. Assuming that a perfect packing schedule could be maintained, one packing table would be kept busy 5 days a week for 6 weeks in repacking these parachutes. Any interruptions to this schedule would obviously increase the time.

To be on the safe side, two tables should be available, provided they are used as intended, for packing purposes by the air groups. A third table placed in the receiving section of the parachute loft would permit a more perfect inspection schedule.

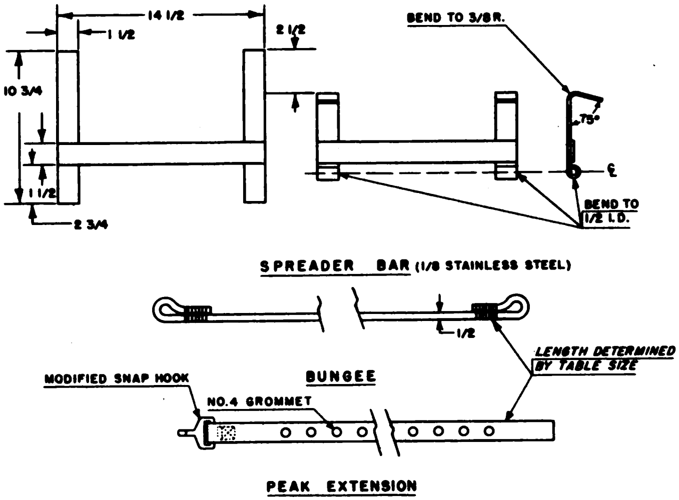


Figure 6–6.—Parachute tensioning device.

Unpacked parachutes, removed from the dry locker preparatory to packing, can be stored on the shelves of the packing tables. Taking this action early in the day clears the dry locker in one operation, and provides the much needed space for new parachutes entering the receiving section.

MAINTENANCE.—The general maintenance of the packing section involves little more than keeping the spaces cleaned and waxed. Every effort should be made to keep all contacting surfaces and edges smooth to prevent snagging the parachute canopy and lines. From the personal angle, the same care holds true for ragged fingernails, which can catch in the yarns of delicate fabrics. Sewing machine maintenance will be treated in the following chapter.

AIR CONDITIONING.—For best results the parachute loft should be air conditioned.

Most fabrics are hygroscopic; that is, they take on and give off moisture to the surrounding atmosphere. If the surrounding air is very humid at the time of packing, much of this dampness will be absorbed by the canopy and be partially retained while packed. Dampness, over a long period of time, is ruinous to almost anything, and nylon is no exception. Nylon fabric is damp resistant and withstands dampness much better than silk without mildewing or losing an appreciable amount of its strength. The main concern over dampness and nylon lies in the time factor; however, do not permit the knowledge of this fact to inspire carelessness.

The reasons for air conditioning a parachute loft where the parachute is handled in its unpacked condition are:

1. Controlled temperature and humidity prevents excessive dampness or dryness of the canopy material.
2. Controlled temperature and humidity reduces the tendency of loft personnel to perspire, thus reducing the danger of perspiration damage to the canopy material.
3. Excessively dry cloth is more likely to generate static electricity. If the parachute is packed under conditions conducive to the production of static electricity, the electricity is, in effect, packed along with the canopy. If this parachute should be jumped on a cold dry day,

it may open rather slowly. The static electricity causes the folds of the canopy to cling to each other.

4. Keep the area free from dust.

Dry Locker

The outstanding feature of a parachute loft is the dry locker, or the drying tower, as it is sometimes called. This structure is distinguished by its box-like height towering over the adjoining one story building. The height of the dry locker is determined (ideally) by the length of the parachute from the peak, at the top of the canopy, to the ends of the leg straps on a seat or back type harness. A 28-foot parachute, suspended freely, requires a height of approximately 45 feet.

PARACHUTE SUSPENSION.—The methods used to suspend a parachute vary slightly, depending on the number of parachutes handled daily, available hardware, and ingeniousness of the installation. Figure 6–7 illustrates three methods of suspending a parachute and the equipment involved.

The hoisting lines used to suspend parachutes must be free from harmful agents containing tars and oils. Braided cotton lines are the most flexible and best adapted to this use. SIGNAL HALYARD or CLOTHES LINE can be drawn from standard stock for this purpose. Figure 6–8 illustrates the steps necessary to construct a hoisting line.

LIGHTING.—Many dry lockers are poorly lighted. FLUSH TYPE lighting fixtures are the safest to use in dry locker construction since the material of the parachute could easily be burned if touched by an exposed hot lamp.

Flush type lighting is also limited in its capacity to light a large area. If an insufficient number of these fixtures are used, the resultant lighting will be very poor. To supplement flush type lighting fixtures, a "Cool White" fluorescent lamp, that generates little heat, may be installed on the surface of walls or the overhead. Contact of the canopy with any type of lighting fixture should be avoided regardless of the heat generated. All surfaces should be smooth to pre-

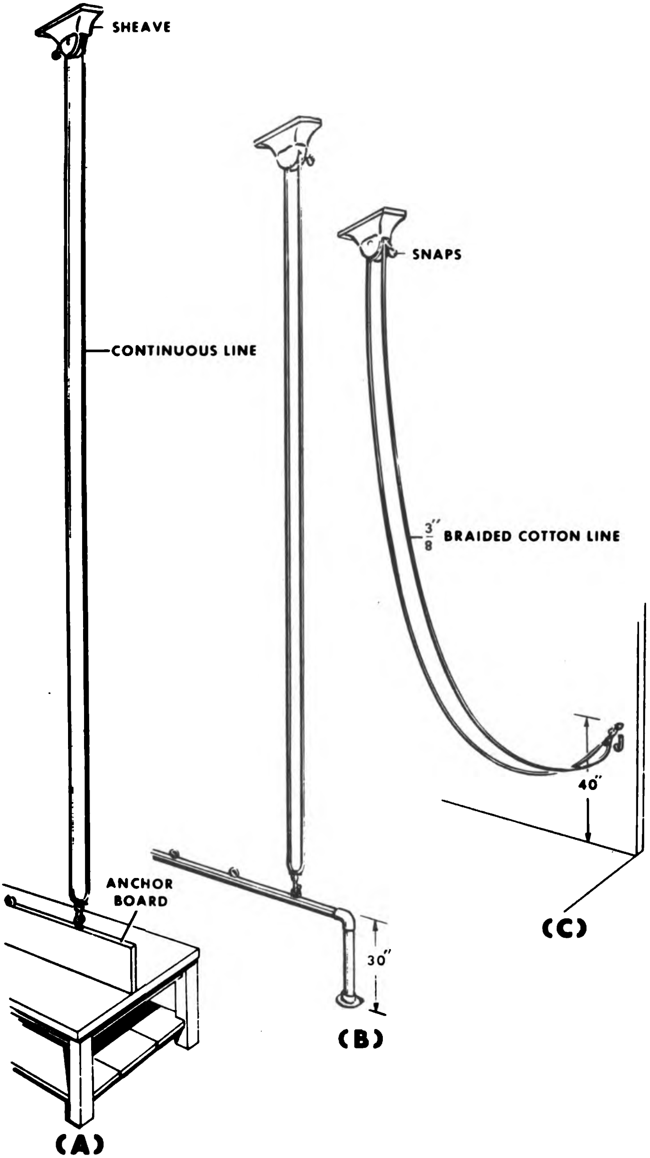


Figure 6–7.—Three methods of parachute suspension.

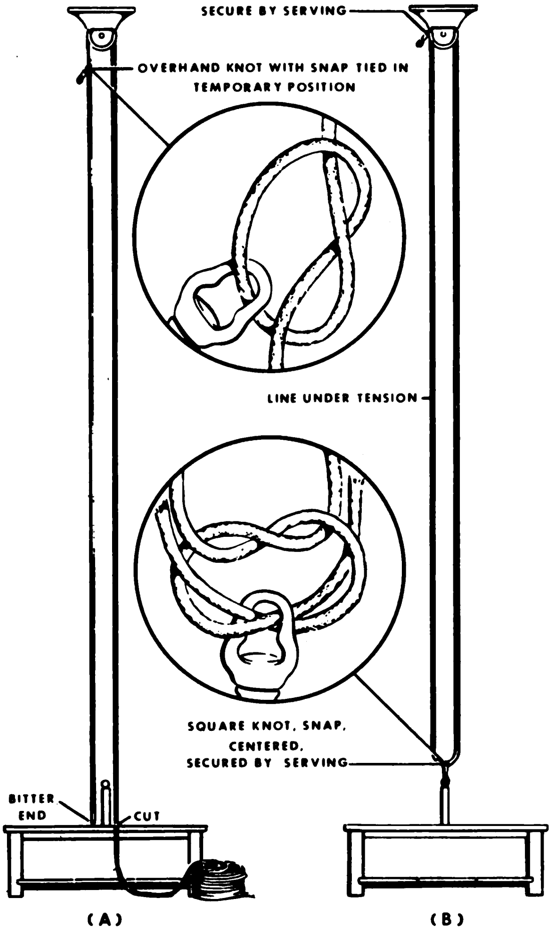

SECURE BY SERVING
OVERHAND KNOT WITH SNAP TIED IN TEMPORARY POSITION
LINE UNDER TENSION
SQUARE KNOT, SNAP, CENTERED, SECURED BY SERVING
BITTER END
CUT
(A)
(B)

Figure 6–8.—How to construct a hoisting line.

vent catching the cloth. Some means of climbing up the inside of the dry locker should be provided to enable personnel to service the hoisting lines and lighting fixtures. A traveling ladder, similar to one used in a shoe store, could easily be installed. This would permit access to all walls and the overhead. In the event walls are obstructed at the floor level, the ladder could be built in two sections, and the bottom section hooked up after the free sliding top half has been placed in position.

Air conditioning.—Every dry locker should be air conditioned with a unit of an appropriate size to maintain the recommended temperature and humidity range for the long life of the parachute.

Humidity control is even more important than temperature, since dampness causes mildew in fabrics. An electric dehumidifying unit can reduce the moisture content of the air. If the air-conditioning unit fails to decrease the humidity, a dehumidifier can be placed in the dry locker to supplement the air conditioner and bring the humidity down to the correct value.

Fabric Work Section

The fabric section is composed mainly of sewing machines and cutting tables.

Sewing machines.—A well-established FASRon parachute loft will have a range of sewing machines that will adequately handle light, medium, and heavy duty work. Light duty work, in most instances, is in the minority; while the medium work, made up of heavily woven cloth and lightweight canvas, requires the greatest amount of time and occupies the most space. Heavy canvas and webbings are in the middle of the workload program and the space and location allotted to these machines should be governed accordingly. Sewing machines are capable of performing perfectly, provided they are given the proper care and are used on the materials they were designed to handle. It is the responsbility of the Parachute Rigger in charge of the loft to see that the sewing machines are kept running and are not abused. A light duty sewing machine should be used exclusively for nylon cloth and other equally light woven fabrics. The light duty sewing machine reserved for medium work has a much greater range and both will be discussed in the following chapter along with other standard types.

CUTTING TABLE.—A cutting table should be about 33 inches high, so that the operator may comfortably perform any cutting operation. The table should be at least 54 inches wide to handle the most popular widths of materials. The length depends on the available area and the workload.

LOCKERS.—Any number of small items like measuring instruments, cutting, stapling, and setting tools should be safely stowed in lockers.

FABRIC CONVEYER.—A full bolt of fabric weighs about 150 pounds. This material must be easily moved about the shop. A fabric conveyer of a simple and strong design as shown in figure 6–9 will serve this purpose. Notice the large rubber casters, the heavy two-inch pipe, and the steel beams. This unit was constructed to withstand a load of 700 pounds.

Not all fabric conveyers need to be portable. The major part of the work being performed, the location, and the

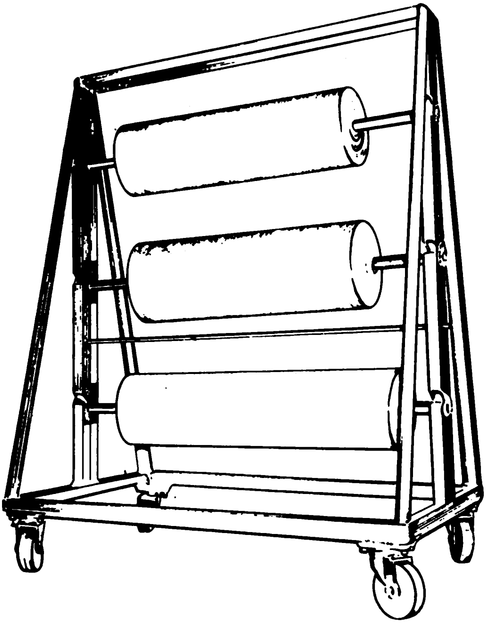


Figure 6–9.—Fabric conveyer.

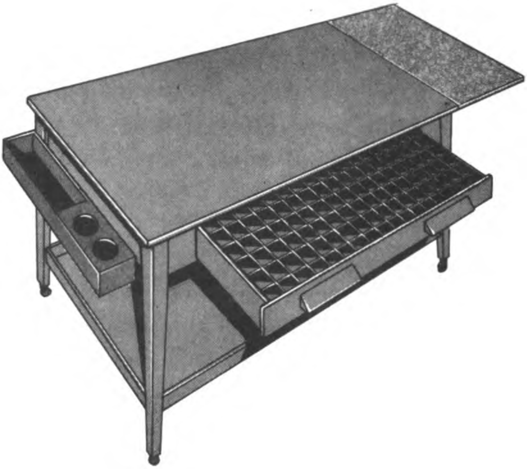


Figure 6–10.—Stenciling table.

facilities of the fabric section will determine the design of the conveyer.

STENCILING TABLE.—A table especially designed for stenciling purposes is a useful accessory. The construction should be heavy and sturdy with top dimensions large enough to accommodate a packed seat type parachute when laid out flat. A large drawer can be used to store two sizes of adjustable stencils and hold small accessories like felt pads and discarded toothbrushes adapted as stenciling brushes. Arranged along the side is a nonspill holder for stenciling fluid. The bottom shelf can be used to store clean containers or anything else that will make a stenciling job easier to perform and neater. Figure 6–10 illustrates this device.

WAX POT AND SEARING WIRE STAND.—Any parachute loft handling a large workload should be equipped with a wax pot stand and a searing wire. The electrically heated wax pot contains a mixture of beeswax and paraffin. This mixture is used for dipping the cut ends of cotton and linen webbings and tapes to prevent fraying. For the same purpose, a searing wire, insulated, and rigged across a three-inch bridge, is used to sever and sear NYLON webbings and tapes. The stand can be rigged with one or more wax pots that can be plugged into receptacles located on the backboard of the stand designed with switches and indicating lights. The searing element, or hot wire, can be permanently installed on the stand with a switch and indicating light. The light glows when the switch is ON.

Laundry

This is NAVAL AVIATION, and since NAVY is associated with WATER, salt water, it is only logical to expect an occasional salt water soaked parachute. Every FASRon and NAS loft can be equipped with inexpensive, slate, wash tubs located in a separate section remote from the dry locker for the purpose of rinsing their parachutes.

DRYING.—Hoisting lines rigged directly over the tubs offer an excellent means of pulling the parachutes out of the rinse water. The better equipped laundry will have an exhaust fan installed about 30 feet from ground level to move a greater quantity of air through the wet fabric than would otherwise be possible.

Life Raft Section

Talcs, cements, and solvents, used in life raft maintenance, can be harmful to parachutes. Fumes from acids and ammonia can be ruinous. A parachute loft and a welding shop, located side by side, are out of place. The life raft section, due to the nature of work performed, should be separated from the parachutes. Small establishments have no choice in the matter, and must take precautions not to contaminate the parachutes with talcum powder and other injurious materials. Talc is a mild abrasive and is harmful to the fine fibres of a canopy, especially in large quantities. The life raft, life vest, and all other rubber flotation gear, with maintenance equipment, will be discussed in volume 2 of this series; also, the same holds true for the oxygen laboratory.

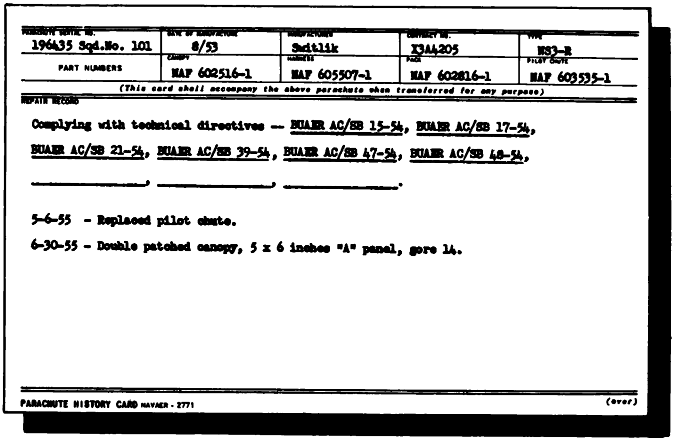
Inflammable Gear Locker

All inflammables are to be stored in special lockers or shacks outside of the parachute loft. When in doubt about the inflammable characteristics of liquids or pastes, check with the Station Fire Department. Regardless of an outside location of the inflammables, the structures housing them should be ventilated. Some inflammables are rendered useless if frozen and must be stored at temperatures well above freezing. Before any one of these items can be stored indoors in metal lockers away from heat sources, special permission must be secured from the Squadron and Station First Lieutenant. These officers are guided by local Station Regulations and the Fire Chief, who is responsible to the Commanding Officer for the fire security of all buildings and structures located on the base.

Avoid spontaneous combustion. Oil and paint-soaked rags should be placed in special containers provided for the purpose. On a temporary basis, and when in doubt about the combustion potentials of any liquid-soaked rag, hang it where the air can circulate freely around it. Never store dirty rags in a heap.

Office

Paperwork and office are more or less synonymous. The business of saving lives involves paperwork, the amount depending on the volume and variety of lifesaving equipment handled by a particular organization. We wouldn't expect the Parachute Rigger to invite us into his office, but we would expect him to have in his possession a complete up-to-date file on all of the necessary publications to properly conduct his business. This would also include records of parachute inspections and packing dates, including modifications (Parachute History Cards); life raft inspections and packing dates; life vest inspections; oxygen system ground crew checks; oxygen regulator bench checks; oxygen regulator changes; oxygen cylinder contamination tests; inspection and test of aircraft safety harness; and inspection of fire



PARACHUTE SERIAL NO.	DATE OF MANUFACTURE	MANUFACTURER	CONTRACT NO.	TYPE
196435 Sqd.No. 101	8/53	Switlik	X3A4205	NS3-R
PART NUMBERS	CANOPY NAF 602516-1	HARNESS NAF 605507-1	PACK NAF 602816-1	PILOT CHUTE NAF 603535-1

(This card shall accompany the above parachute when transferred for any purpose)

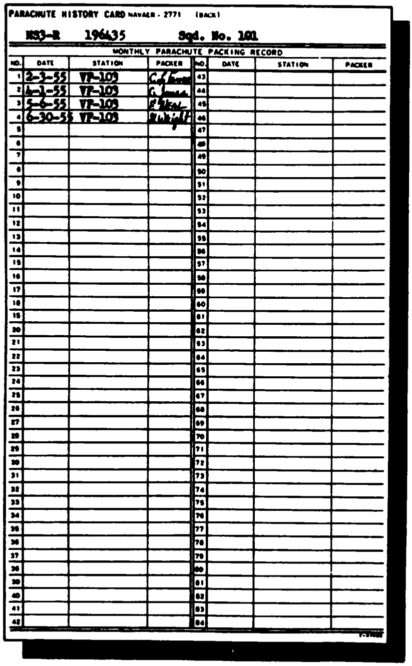
REPAIR RECORD

Complying with technical directives — BUAER AC/SB 15-54, BUAER AC/SB 17-54, BUAER AC/SB 21-54, BUAER AC/SB 39-54, BUAER AC/SB 47-54, BUAER AC/SB 48-54, ________, ________, ________.

5-6-55 - Replaced pilot chute.

6-30-55 - Double patched canopy, 5 x 6 inches "A" panel, gore 14.

PARACHUTE HISTORY CARD NAVAER - 2771 (over)



PARACHUTE HISTORY CARD NAVAER - 2771 (BACK)

NS3-R 196435 Sqd. No. 101

MONTHLY PARACHUTE PACKING RECORD

NO.	DATE	STATION	PACKER	NO.	DATE	STATION	PACKER
1	2-3-55	VP-103	[illegible]	43			
2	4-1-55	VP-103	G. Jones	44			
3	5-6-55	VP-103	[illegible]	45			
4	6-30-55	VP-103	R. Wright	46			
5				47			
6				48			
7				49			
8				50			
9				51			
10				52			
11				53			
12				54			
13				55			
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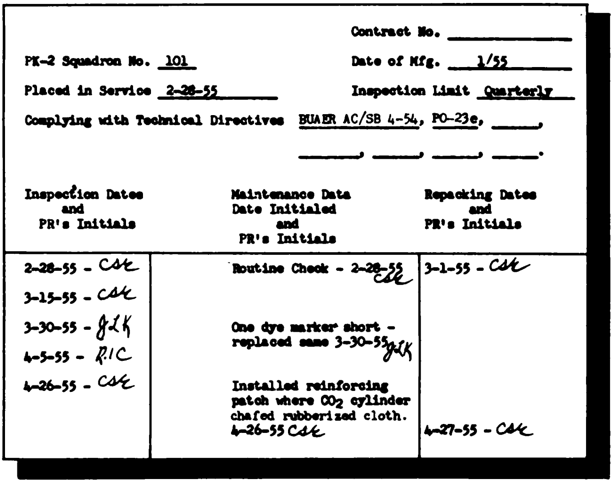
39				81			
40				82			
41				83			
42				84			

Figure 6–11.—Parachute record.



Contract No. ______________

PK-2 Squadron No. 101

Date of Mfg. 1/55

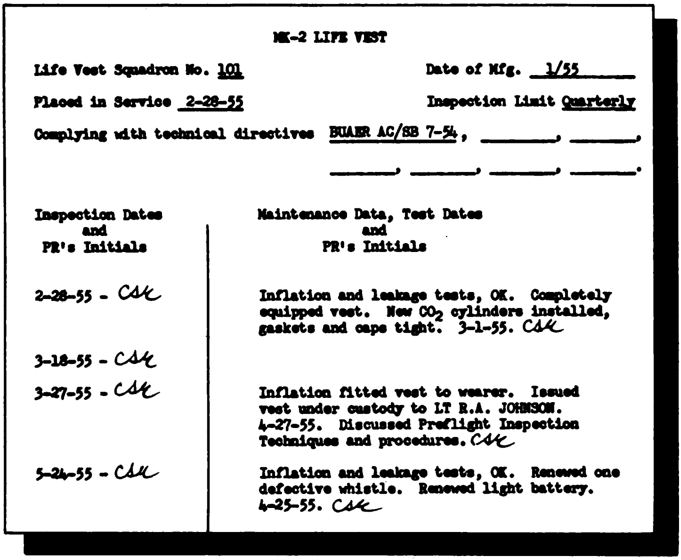
Placed in Service 2-28-55

Inspection Limit Quarterly

Complying with Technical Directives BUAER AC/SB 4-54, PO-23e, ______, ______, ______, ______, ______.

Inspection Dates and PR's Initials	Maintenance Data Date Initialed and PR's Initials	Repacking Dates and PR's Initials
2-28-55 - CAK	Routine Check - 2-28-55 CAK	3-1-55 - CAK
3-15-55 - CAK		
3-30-55 - JLK	One dye marker short - replaced same 3-30-55 JLK	
4-5-55 - RIC		
4-26-55 - CAK	Installed reinforcing patch where CO_2 cylinder chafed rubberized cloth. 4-26-55 CAK	4-27-55 - CAK

Figure 6–12.—Pararaft kit record.



MK-2 LIFE VEST

Life Vest Squadron No. 101

Date of Mfg. 1/55

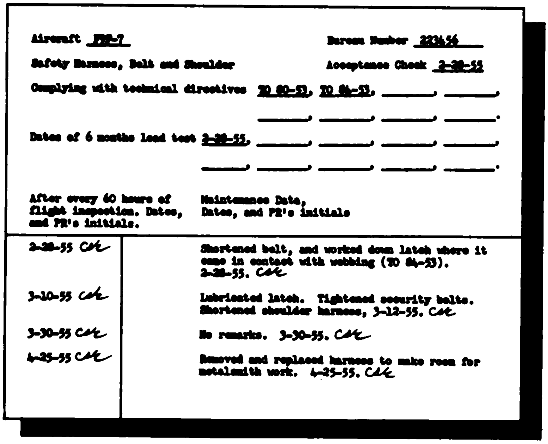
Placed in Service 2-28-55

Inspection Limit Quarterly

Complying with technical directives BUAER AC/SB 7-54, ______, ______, ______, ______, ______, ______.

Inspection Dates and PR's Initials	Maintenance Data, Test Dates and PR's Initials
2-28-55 - CAK	Inflation and leakage tests, OK. Completely equipped vest. New CO_2 cylinders installed, gaskets and caps tight. 3-1-55. CAK
3-18-55 - CAK	
3-27-55 - CAK	Inflation fitted vest to wearer. Issued vest under custody to LT R.A. JOHNSON. 4-27-55. Discussed Preflight Inspection Techniques and procedures. CAK
5-24-55 - CAK	Inflation and leakage tests, OK. Renewed one defective whistle. Renewed light battery. 4-25-55. CAK

Figure 6–13.—Life vest record.



Aircraft F9F-7 Bureau Number 223456

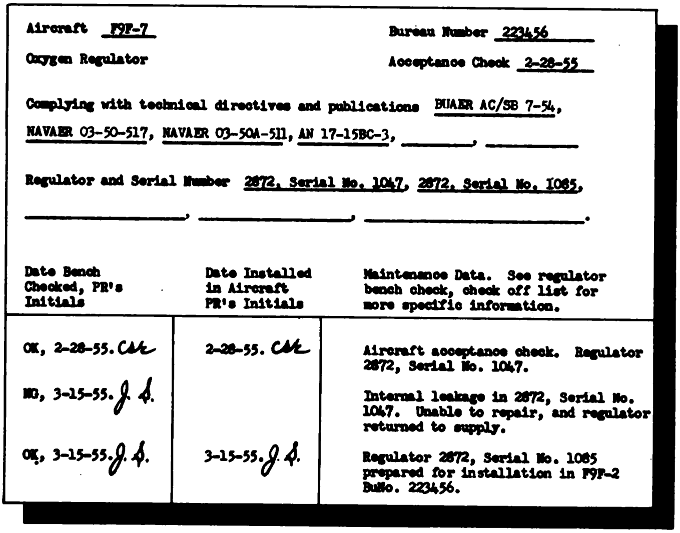
Safety Harness, Belt and Shoulder Acceptance Check 2-28-55

Complying with technical directives TO 80-53, TO 84-53, ______, ______, ______, ______, ______, ______.

Dates of 6 months load test 2-28-55, ______, ______, ______, ______, ______, ______, ______, ______, ______.

After every 60 hours of flight inspection. Dates, and PR's initials.	Maintenance Data, Dates, and PR's initials
2-28-55 CAE	Shortened belt, and worked down latch where it came in contact with webbing (TO 84-53). 2-28-55. CAE
3-10-55 CAE	Lubricated latch. Tightened security belts. Shortened shoulder harness, 3-12-55. CAE
3-30-55 CAE	No remarks. 3-30-55. CAE
4-25-55 CAE	Removed and replaced harness to make room for metalsmith work. 4-25-55. CAE

Figure 6–14.—Safety belts and shoulder harness inspection log entry.



Aircraft F9F-7 Bureau Number 223456

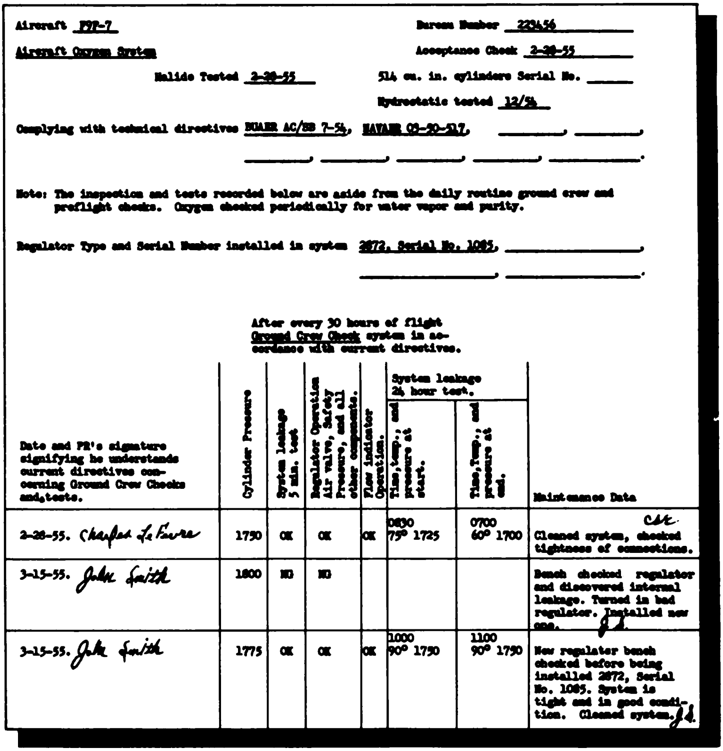
Oxygen Regulator Acceptance Check 2-28-55

Complying with technical directives and publications BUAER AC/SB 7-54, NAVAER 03-50-517, NAVAER 03-50A-511, AN 17-15BC-3, ______, ______

Regulator and Serial Number 2872, Serial No. 1047, 2872, Serial No. 1085, ______, ______, ______.

Date Bench Checked, PR's Initials	Date Installed in Aircraft PR's Initials	Maintenance Data. See regulator bench check, check off list for more specific information.
OK, 2-28-55. CAE	2-28-55. CAE	Aircraft acceptance check. Regulator 2872, Serial No. 1047.
NG, 3-15-55. J. A.		Internal leakage in 2872, Serial No. 1047. Unable to repair, and regulator returned to supply.
OK, 3-15-55. J. A.	3-15-55. J. A.	Regulator 2872, Serial No. 1085 prepared for installation in F9F-2 BuNo. 223456.

Figure 6–15.—Oxygen regulator record.



Aircraft F9F-7 Bureau Number 229456

Aircraft Oxygen System Acceptance Check 2-28-55

Halide Tested 2-28-55 514 cu. in. cylinders Serial No. ______

Hydrostatic tested 12/54

Complying with technical directives BUAER AC/SB 7-54, NAVAER 03-50-517, ______, ______, ______, ______, ______, ______, ______.

Note: The inspection and tests recorded below are aside from the daily routine ground crew and preflight checks. Oxygen checked periodically for water vapor and purity.

Regulator Type and Serial Number installed in system 2872, Serial No. 1085, ______, ______, ______.

After every 30 hours of flight Ground Crew Check system in accordance with current directives.

Date and PR's signature signifying he understands current directives concerning Ground Crew Checks and tests.	Cylinder Pressure	System leakage 5 min. test	Regulator Operation Air valve, Safety Pressure, and all other components.	Flow indicator Operation.	System leakage 24 hour test.		Maintenance Data
					Time, temp., and pressure at start.	Time, Temp., and pressure at end.	
2-28-55. Charles LeFevre	1750	OK	OK	OK	0830 75° 1725	0700 60° 1700	CLF. Cleaned system, checked tightness of connections.
3-15-55. John Smith	1800	NG	NG				Bench checked regulator and discovered internal leakage. Turned in bad regulator. Installed new one. JS
3-15-55. John Smith	1775	OK	OK	OK	1000 90° 1750	1100 90° 1750	New regulator bench checked before being installed 2872, Serial No. 1085. System is tight and in good condition. Cleaned system. JS

Figure 6–16.—Oxygen system inspection and test record.

extinguishing systems, where and when installed. At the present time, there are no particular recording forms other than the Parachute History Card for maintaining office records of lifesaving equipment.

Many record forms are locally determined. Records are valuable for dozens of different reasons and nothing is more valuable than a COMPLETE ACCOUNT when trouble upsets the pattern of normal routine.

Study all publications related to your work. Make certain that the records prepared cover everything, including serial numbers, and are neatly compiled. Keep a rough and a smooth log. The smooth log should be readily available and should be kept up to date on a weekly or monthly basis, depending on conditions.

Large establishments justifiably need office space for filing records, issuing job orders, preparing watch lists, compiling publications, and innumerable similar tasks associated with office work.

Figures 6–11 through 6–16 illustrate a number of typical inspection log entries made by a Parachute Rigger. The record is indicative of the equipment of one particular squadron and is not to be interpreted as an overall model.

Technical Library

All operating units of the Navy are required to maintain files of publications on the mechanical equipment they use. In order to keep this tremendous volume of technical data up to date requires the services of hundreds of people operating from a central agency. Millions of dollars are spent annually for disseminating technical information throughout the fleet and other units. For example, a certain piece of equipment breaks down because of some inherent mechanical defect, or a new and revolutionary procedure is developed that will make an operation safer and more accurate. These and dozens of other conditions both beneficial or harmful would remain relatively unknown if it were not for the Navy publications. Take advantage of your technical library, local or remote, and learn all there is to know about the effectiveness, and reliability of the equipment in your charge. Keep up to date by using the *Naval Aeronautic Publications Index*, NavAer 00–500, and its supplements.

Familiarize yourself with aircraft manuals and pilot's handbooks relative to the squadron. In this way you will be able to apply your training more effectively.

Storeroom

The storeroom needs no introduction other than a word of caution: Do not enter a storeroom unless authorized by proper authority; never leave it unlocked and unattended. Here are two simple statements to remember and they will serve to prevent disagreeable circumstances. Almost any storeroom, the responsibility of which lies with the Commanding Officer, represents an investment involving large sums of money. Do not jeopardize his position through negligence or ignorance.

A storeroom should carry items of equipment which are needed for everyday use and replacement. Provisions for issuing and receiving materials without confusion should be included in the physical layout of any storeroom.

REQUISITIONING MATERIAL.—Performing all the tasks involved in an operating squadron leaves a Parachute Rigger with little time for specialization. He must perform all of the varied jobs of his rating. He should be able to order equipment accurately and intelligently, and in accordance with the policies of his unit. He should be able to use the indexes provided for ASO and Standard Stock Material. He should be cost conscious and use the cheapest materials available, consistent with safety, that will do the job. He should maintain a file on past and pending requisitions in the interest of efficiency and self-protection.

Before turning over a piece of "accountable" equipment to his unit storekeeper, he should get a receipt for that specific item showing the serial number. Help eliminate mistakes in crediting. Cooperate with storekeepers and mark all containers plainly, giving complete information on the equipment contained. Anticipate your needs and do not wait until the last minute to order an item.

A step-by-step procedure for requisitioning material follows:

1. Use correct nomenclature as listed in the catalog.
2. Fill out a preliminary requisition stub and give the stock number, nomenclature, and quantity desired. Date it, sign it, and record it, or keep a carbon copy for your file. Be sure to include the name for your department: PARACHUTES.
3. Some squadrons require the Parachute Officer's signature on a preliminary requisition. This is a good practice since it gives the Parachute Officer a good running

account of the money and material being expended in his department.

4. Turn your requisition over to the unit storekeeper responsible for preparing the regular material requisition form which must be signed by the unit's Supply Officer.
5. After a reasonable amount of elapsed time, check on your order.
6. Sign the related requisition stub when receiving the order and mark the record received.

STORAGE PROBLEMS.—Protect your parachutes from rodents and other pests. Store unpacked parachutes in closed containers. Dampness should no longer be a problem since there are so many reliable and efficient dehumidifiers available.

Overstocking is a wasteful process.

TEMPERATURE AND HUMIDITY

Where air conditioning is available, the temperature and humidity table 6–1 will serve as a guide.

Table 6–1.—Parachute loft temperature and humidity ranges.

Location	Range	Temperature	Relative humidity
Dry Locker	Ideal	70° F	40%.
	Safe average	60° to 85° F	30% to 60%.
Storage	Ideal	70° F	40%.
	Safe average	60° to 75° F	30% to 60%.
Packing loft	Ideal	75° F	60%.
	Safe average	60° to 85° F	30% to 60%.

NOTE: The maximum temperature for any space is 110° F.

Air is a mixture of several gases, chiefly nitrogen, oxygen, and carbon dioxide. The atmosphere contains these gases in a definite ratio whereas the evaporated water called WATER VAPOR varies in amount but is never more than 4 percent by volume of the atmosphere.

PSYCHROMETER.—This is an instrument used for measuring the amount of water vapor present in the atmosphere. The instrument consists of a **WET-BULB** and a **DRY-BULB THERMOMETER.**

As the water evaporates from the wick around the wet bulb it is cooled, giving a lower reading than that of the dry unit. The faster the water evaporates, the lower the reading on the wet-bulb thermometer. If no evaporation occurs (if the air is saturated), both thermometers will give the same reading.

Knowing both wet- and dry-bulb temperatures, the absolute and relative humidity may easily be determined from carefully prepared charts accompanying each instrument.

The amount of water vapor which a given volume will hold is dependent upon the temperature. A cubic foot of saturated air at 70° F. contains 8.07 grains (1 lb.=7,000 grains).

SLING PSYCHROMETER.—The standard psychrometer, when used as a portable hand-whirled instrument, is termed a **SLING PSYCHROMETER**, shown in figure 6–17. The sling consists of a wooden grip with a swivel head and harness type snap or spring clip for attaching to the top hole of the psychrometer frame.

When not in use the sling psychrometer should be hung on a suitable hook and in a secure position away from the possibility of damage.

For a check on humidity, remove the psychrometer from the hook and take it to a clear, open place, preferably exposed to the wind. Never touch the bulb or stem in handling or expose to the direct rays of the sun while making an observation. The bulb of the wet-bulb thermometer, which is covered with a wick, is wet at the time an observation is made. Stand in a clear place facing into the wind, and hold your arm close to your body, forearm extended, shading the psychrometer with the body. Rotate the psychrometer with the wrist. For the best results, whirling should produce an airflow of not less than 15 feet per second (approx. 120 r. p. m.). Bring the instrument to a stop without any sharp jar, lifting it to eye level and read both thermometers to the nearest tenth of a degree, reading the wet bulb first. The

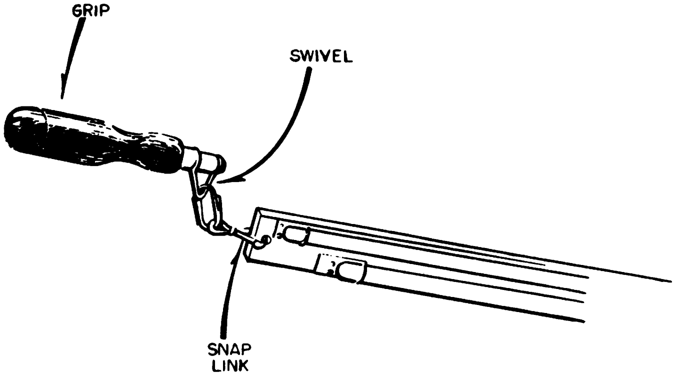


Figure 6–17,—Sling psychrometer.

whirling is repeated and other readings are made until the wet-bulb temperature fails to show further decline.

When freezing temperatures are encountered, remove the wick and apply distilled water to the bulb, using a camel's-hair brush, until a thin coating of ice covers the wet bulb. Then take the observation in the manner described above, keeping in mind that it takes considerably longer to get an accurate wet-bulb reading under these conditions.

When taking the psychrometer reading indoors, continue the process in any confined section of the parachute loft, dry locker, storeroom, packing section, or wherever a reading is desired. When the indoor readings have been completed, a comparison with outdoor conditions will be possible.

Calculate the difference between the dry-bulb and the wet-bulb temperature readings. After the difference is obtained, the next step is to enter on the tables, based on the barometric pressure nearest the normal station pressure. The tables are found in the U. S. Weather Bureau Publication No. 235. The arguments are the dry-bulb temperature as given in the vertical column at the left of the table, and the depression of the wet-bulb printed across the top of the table. Dew-point and relative humidity data are given as tabular values on correspondingly captioned pages.

For example: Suppose the barometer reading is 30.00 "Hg." (read 30 inches of mercury), the dry-bulb temperature is 69° F., and the wet-bulb temperature is 61° F. (Refer to table 6–2.) The left-hand column is headed, "Air Temperature." This is dry-bulb temperature and is in degrees Fahrenheit. The other columns are headed, "Depression at wet-bulb thermometer." This "Depression" is the difference in the readings at the wet- and dry-bulb thermometers. In this example, the depression is 69 minus 61, or 8° F. Locate 69° F. in the left-hand column. Follow horizontally to the right on this line to the column headed 8.0. Now, read the value of the relative humidity, which in this case is 63 percent.

HYGROTHERMOGRAPH.—The humidity element of the hygrothermograph, the standard instrument for the measuring and recording of relative humidity, consists of separate bundles of the best grade natural blonde human hair, about 50 strands in all, spread into 8 groups. The hair element increases in length with rising or high humidities and decreases in length with falling or low humidities. These changes in length make it possible to make humidity markings on a record chart.

The relative humidity hair element is secured at the lower end to a pivoted end clamp. This is similar to that of the temperature element and permits adjustment of hair tension when setting to current humidity. The upper end of the element is attached to a small lever arm that operates the upper lever cam through a vertical link and lever arm. The pen arm is of the pressure gravity type.

The humidity is read on a hygrothermograph chart by first finding the point at which the appropriate printed time curve intersects the humidity trace. This point is evaluated in terms of humidity by referring it to the closest of the horizontal printed lines of the chart. These lines correspond to the engraved markings found on various instruments, the scale being based on relative humidity values from 0 to 100. Interpolation may be necessary for values of humidity and time between those corresponding to the

Table 6–2.—Relative humidity, percent-Fahrenheit temperatures (pressure=30.0 inches); portion of U. S. Weather Bureau Publication No. 235.

Air temperature	Depression of wet-bulb thermometer														
	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0
65	90	87	85	82	80	77	75	72	70	68	66	63	61	59	56
66	90	87	85	82	80	78	75	73	71	68	66	64	61	59	57
67	90	87	85	83	80	78	75	73	71	69	66	64	62	60	58
68	90	88	85	83	80	78	76	74	71	69	67	65	62	60	58
69	90	88	85	83	81	79	76	74	72	70	67	65	63	61	59
70	90	88	86	83	81	79	77	74	72	70	68	66	64	61	59
71	90	88	86	84	81	79	77	75	72	70	68	66	64	62	60
72	91	88	86	84	82	79	77	75	73	71	69	67	65	63	61
73	91	88	86	84	82	80	78	75	73	71	69	67	65	63	61
74	91	89	86	84	82	80	78	76	74	71	69	67	65	63	61

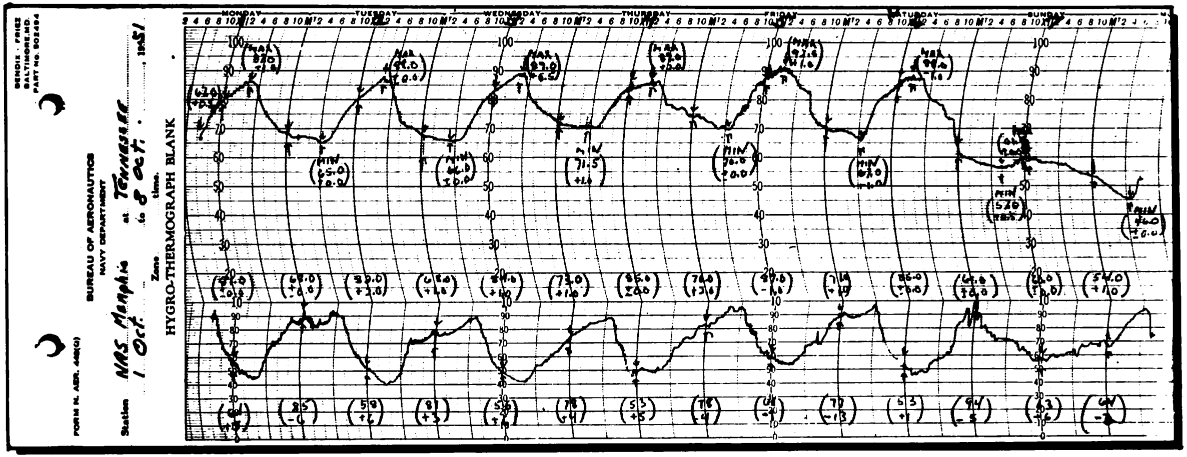


Figure 6–18.—Traces on the hygrothermograph chart.

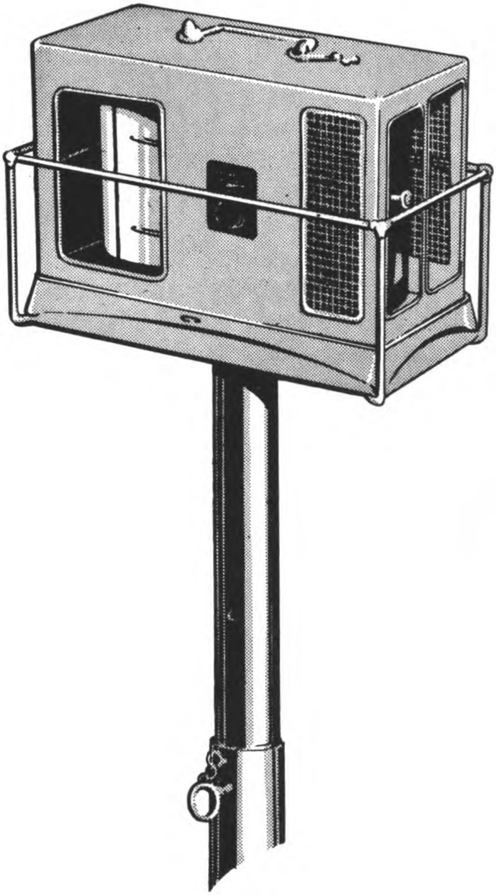
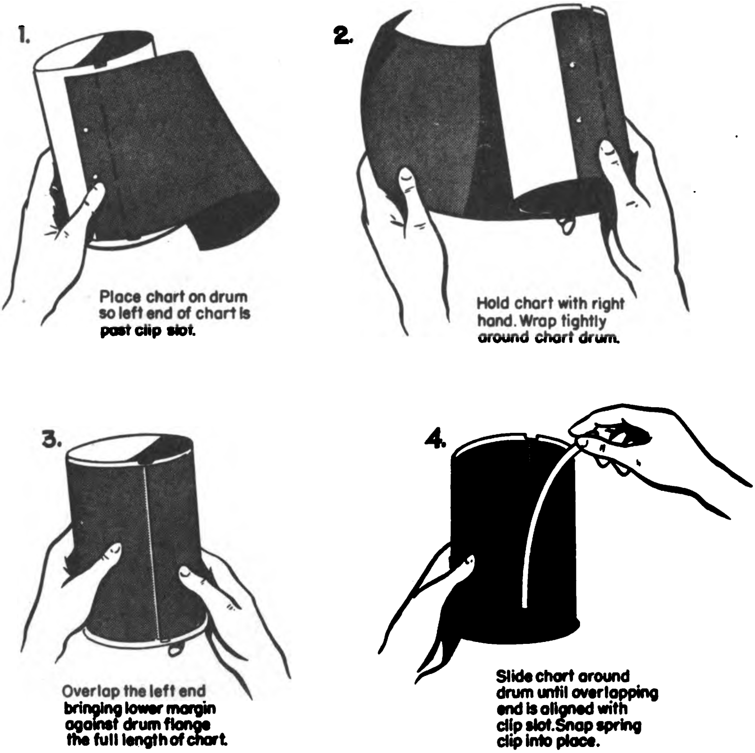


Figure 6–19.—Hygrothermograph mounted on telescoping stand.

printed lines of the chart. The current humidity adjustment is made if the error of the reading on the chart is in excess of 5 percent from the relative humidity obtained from the psychrometric reading. (See fig. 6–18.)

The hygrothermograph should be mounted on a horizontal platform, centrally located with the base 3 feet from the floor of the dry locker. (See fig. 6–19.)

The graph or chart should be filed for future reference and



Place chart on drum so left end of chart is past clip slot.

Hold chart with right hand. Wrap tightly around chart drum.

Overlap the left end bringing lower margin against drum flange the full length of chart.

Slide chart around drum until overlapping end is aligned with clip slot. Snap spring clip into place.

Figure 6–20.—Steps in mounting the hygrothermograph chart.

comparison. In this way the effectiveness of an air-conditioning system can be evaluated. In the absence of an air-conditioning unit, the records compiled by a hygrothermograph can justify the reasons for installing air conditioning. The chart is very simply installed on a rotating drum of the instrument which is spring-operated to run with the accuracy of a clock. Figure 6–20 illustrates the steps used in mounting a chart on the drum.

Conversion of Fahrenheit and Centigrade

Publications making reference to temperatures usually give each of them in both Fahrenheit and centigrade. Occasionally, however, only one scale is referenced. In view of this fact and the possibility of a conversion table not being readily available, it is an asset to know how to convert the temperature scales mathematically.

Five centigrade degree divisions are equal in scale value to nine Fahrenheit degree divisions, and 0° on the centigrade scale corresponds to 32° on the Fahrenheit scale. Both scales have the same temperature value at $-40°$, that is $-40°$ C. is the same identical temperature value as $-40°$ F.

To convert from the Fahrenheit to the centigrade scale, first determine the number of Fahrenheit degrees the given temperature is above or below the freezing point (32° F.), and then multiply by $5/9$. To convert from centigrade to Fahrenheit, first multiply by $9/5$ in order to find the number of Fahrenheit degrees the given temperature is above or below the freezing point.

There are 32 degrees on the Fahrenheit thermometer before the freezing point is reached and zero degrees on the centigrade thermometer. The ratio existing between Fahrenheit degrees and centigrade degrees is 180 to 100, or $180/100$. Hence,

$$\frac{F-32}{C} \text{ equals } \frac{180}{100}.$$

Therefore, to change centigrade to Fahrenheit, multiply by $9/5$ and add 32 to the product. To convert Fahrenheit to centigrade, subtract 32 from the Fahrenheit reading and multiply by $5/9$.

PROBLEMS CONFRONTING THE AIR GROUP RIGGER

Supply.—Allowance lists do not always provide for the maintenance of CO_2 and oxygen equipment. It is necessary that the Parachute Rigger be prepared to justify, in writing, the reasons for drawing certain tools in excess of allowance. Present your justification to the Squadron Supply Officer via the Parachute Officer.

Do not wait until the last minute to order a particular item. Anticipate the demand and order equipment early enough to meet the work schedule. Squadrons move around a great deal, sometimes changing from one base to another in a matter of months. It will be necessary to reorder equipment not delivered at the old station as the material obligation is not transferable. Whenever obligating material not in stock, take time to check on the expected delivery date, as the squadron may be transferred before the material can be delivered. Emergencies are treated differently from normal stock channels. Do not try to handle material emergency orders alone. The Parachute Officer will make the arrangements while you assist him in every detail.

When a technical publication has been received that specifies a modification of equipment on hand and lists the material necessary to do the job, order the material immediately. Make a record of the order directly on the publication and in the record book. When the modification has been completed report to the Parachute Officer that you have complied with the directive. Follow-up on every order. Be especially careful when ordering materials connected with any modification directive.

MOVING ON AND OFF THE AIRCRAFT CARRIER.—The Parachute Rigger is not confronted with any serious problems of packing his gear when preparing to embark aboard an aircraft carrier. Most of the parachutes are flown aboard in aircraft and only the spares need be packed for shipment with other squadron gear. A parachute bag is usually satisfactory as the shipping container, and will offer a fair degree of protection. However, the bag isn't crush proof, and certain precautions are necessary to protect the parachute from being damaged. The best method of protection is to ship the spare parachutes with the personal gear of the crew. Do not permit them to be loaded in cargo nets with tool boxes, cruise boxes, and other heavy metal objects.

When your gear is hoisted aboard, be there to receive it and move it immediately to the spaces assigned, as the parachute loft facilities may not be large enough to accommodate everyone's equipment. Secure all loose boxes with line or cable of adequate strength. Cooperate with the ship's company men.

In preparing to disembark, take time to clean up. Make certain that all gear belonging to the ship and held in your custody is safely returned and acknowledged.

DEALING WITH FASRON.—The Squadron Rigger's association with a FASRon and an air station activity can be pleasant. A few items to bear in mind that will be helpful in establishing a good working relationship follow:

1. Help keep the spaces clean.
2. Observe the working schedule of others and do not stack your gear on the tables or take up floor space without checking with everyone concerned. Follow this and you won't be an interference.
3. Air and dry your parachutes for the minimum period and clear the dry locker for the next man's use.
4. Do not attempt to repair a sewing machine without the authority of the Parachute Rigger in charge of the loft.
5. Return all gear so that you as well as others can use it again.
6. Sign custody receipts and take good care of the gear checked out in your charge.
7. When returning gear held in your custody, insist on the receipt.
8. Do not abuse loft equipment.
9. Keep your feet off the tables and sewing machines. A careless attitude leads to careless working habits. Never "skylark" around lifesaving equipment. Such frivolous conduct could be misconstrued as an indication of the kind of work being performed.

QUIZ

1. In order to determine the material requirements for modification of a piece of equipment in your charge, you would consult
   a. the *BuAer Manual*
   b. the *Parachute Manual*
   c. Technical Publications
   d. the Parachute Officer

2. The maximum percent by volume of water vapor in the atmosphere can be
   a. 4 percent
   b. 6 percent
   c. 8 percent
   d. 12 percent

3. What records are the most important for a Parachute Rigger to maintain?
   a. Parachute History Cards
   b. Technical Publications
   c. Job orders performed
   d. Past and pending requisitions

4. What is the NavAer number of the *Naval Aeronautic Publications Index?*
   a. NavAer 00–500
   b. NavAer 00–501
   c. NavAer 13–5–501
   d. NavAer DD 535

5. Which item is the most harmful to parachutes?
   a. Talc
   b. Acid fumes
   c. Cleaning solvents
   d. Hydraulic fluid

6. Dirty, oily rags should be stored in
   a. a heap outdoors
   b. special lockers located in the oxygen shop
   c. metal lockers in the loft
   d. special lockers outside the loft

7. Which type of line would be used as a hoisting line to suspend parachutes in a dry locker?
   a. Hemp
   b. Rope
   c. Signal halyard
   d. Suspension

8. What is the most suitable height for a cutting table?
   a. 24 inches
   b. 30 inches
   c. 33 inches
   d. 36 inches

9. Under which condition does cloth tend to generate static electricity?
    a. Wet
    b. Damp
    c. Dry
    d. Excessively dry

10. What is the ideal height of a dry locker?
    a. 28 feet
    b. 32 feet
    c. 45 feet
    d. 60 feet

11. The parachute is completely inspected at least once every
    a. 10 days
    b. 30 days
    c. 60 days
    d. 90 days

12. A parachute charged with static electricity would
    a. shock the jumper
    b. weaken the canopy fabric
    c. cause line overs
    d. cause the canopy folds to adhere

13. What is the minimum distance allowed between packing tables?
    a. 1 foot
    b. 2 feet
    c. 3 feet
    d. 6 feet

14. The maximum expected daily workload for a parachute table per day is
    a. 10 parachutes
    b. 15 parachutes
    c. 25 parachutes
    d. 30 parachutes

15. What is the minimum distance that parachute bins should be built from the bulkhead?
    a. Against the bulkhead
    b. 3 inches
    c. 4 inches
    d. 6 inches

16. What is the recommended type of lighting for the parachute loft?
    a. Natural light
    b. Blue light bulbs
    c. Fluorescent
    d. Incandescent

17. Which type of ship offers the best parachute loft facilities?
    a. CVE
    b. CVL
    c. CVA
    d. AVP

18. What is the minimum clearance allowed between the bottom row of parachute bins and the deck?
    a. 4 inches
    b. 6 inches
    c. 12 inches
    d. 18 inches

19. If your squadron is on a CVE at sea and the parachutes assigned are overdue for repacking, you would
    a. wait for shore establishment packing facilities
    b. notify your Parachute Officer that there are no packing facilities aboard
    c. pack on messhall tables to meet the schedule
    d. sign the outside Packing Record Card to the effect that parachutes were repacked

20. A FASRon parachute loft should be centrally located
    a. near the line, accessible to all squadrons
    b. near the industrial area accessible to supply
    c. near the O & R loft so its equipment is accessible to the squadron riggers
    d. with the loft and oxygen shops combined in the same space

21. It is necessary that a small parachute loft have a
    a. packing table, bins, and office
    b. packing table, sewing machine, and wash tubs
    c. sewing machine, storeroom, and packing table
    d. sewing machine, bins, and packing table

22. Given 77° F., what is the reading on a centigrade thermometer?
    a. 25° C.
    b. 30° C.
    c. 45° C.
    d. 60° C.

23. If you are in a squadron and are working in a FASRon loft you would
    a. air and dry your parachutes for the maximum period of time
    b. repair all sewing machines that are not in working order
    c. set up your own working schedule
    d. adhere to the planned schedule.

24. The difference in the temperature readings of a wet- and dry-bulb thermometer is called
    a. barometric reading
    b. relative humidity
    c. depression
    d. dew point

25. Using the hygrothermograph chart (fig. 6–18), what is the relative humidity at 0700 Wednesday?
    a. 66 percent
    b. 90 percent
    c. 77 percent
    d. 54 percent

26. What is the mounting height of the hygrothermograph installed in the dry locker?
    a. Deck level
    b. Three feet
    c. Five feet
    d. Six feet

27. The hygrothermograph chart is installed in the instrument on a
    a. panel
    b. spindle
    c. piston
    d. drum

28. Which action has a cooling effect?
    a. Saturation
    b. Condensation
    c. Humidification
    d. Evaporation

CHAPTER 7

SEWING MACHINES

You will be called upon to perform an enormous quantity of repair work on parachutes and survival equipment. Repair work in this instance means sewing. Sewing, in turn, requires a thorough knowledge of the specialized tools used. Sewing equipment consists of sewing palms, needles, awls, and sewing machines.

The type of stitch commonly used and made by sewing machines in repair work is the LOCKSTITCH, type 301. (See fig. 7–1.) The lockstitch is made by passing the needle and thread through the materials to be sewed. A sewing hook, designed to catch the loop formed by the needle, catches the loop and passes it around a lower thread (the bobbin thread). With the return of the needle back through the material, along with proper thread tension and action of the takeup lever, a perfect lockstitch is made. Properly operating and adjusted machines will make sewing an ease.

Sewing machines may be divided into two types—OSCILLATING and ROTARY. Both types are operated by electric motors and are fitted with rheostats, or special clutch arrangements, that enable the operator to control the speed.

Oscillating type sewing machines are named for the action of the sewing hook which rocks back and forth through half a revolution to complete one stitch.

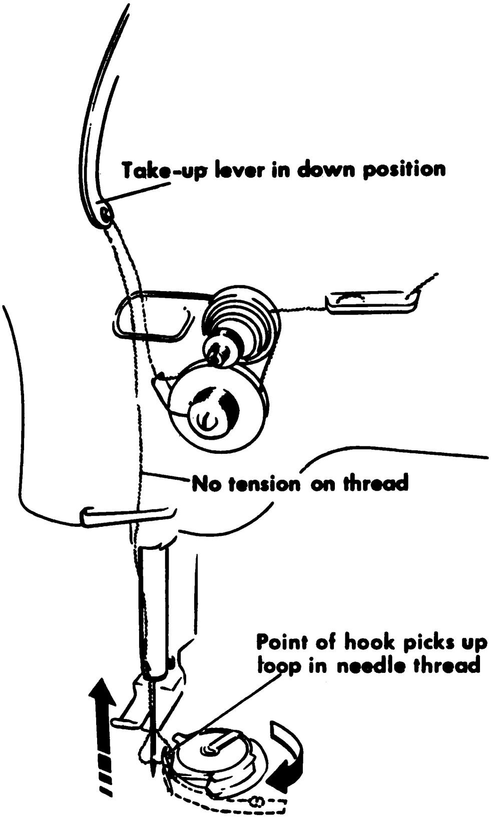

Take-up lever in down position
No tension on thread
Point of hook picks up loop in needle thread

Figure 7–1.—(A) The lockstitch. Point of hook picks up loop of thread.

Rotary type sewing machines are also named for the action of the sewing hook which makes two complete revolutions to complete one stitch.

Machines falling within both types will be discussed in this chapter.

It must be remembered that a manufacturer's parts list and operation manual is required to properly service each class of machine.

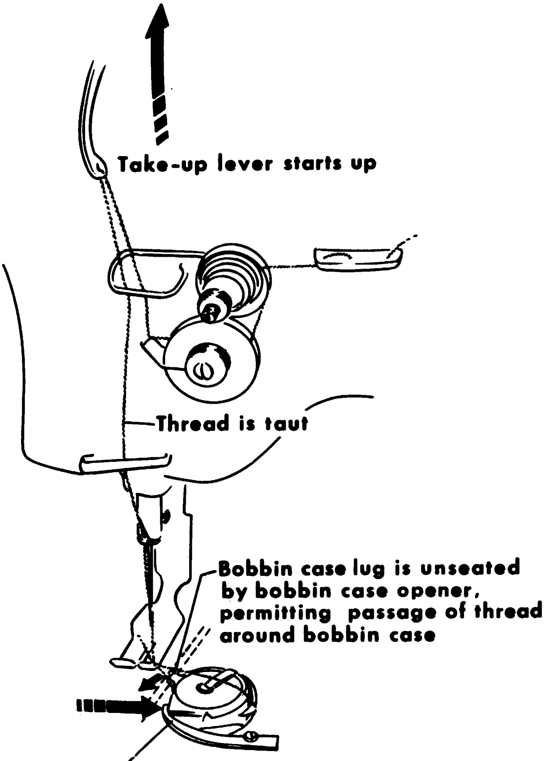

Take-up lever starts up
Thread is taut
Bobbin case lug is unseated by bobbin case opener, permitting passage of thread around bobbin case
BOBBIN CASE OPENER

Figure 7–1.—(B) The lockstitch. Needle thread being drawn around bobbin.

SINGER SEWING MACHINE 31–15

The 31–15 is an oscillating type sewing machine of moderate speed which makes a lockstitch. It is intended for sewing clothing, is best for nylon cloth sewing, and is used for sewing lightweight canvas up to 8 ounces. The Singer Sewing Machine 31–15 is illustrated in figure 7–2.

When the machine is in operation, the BALANCE WHEEL TURNS over TOWARD the operator.

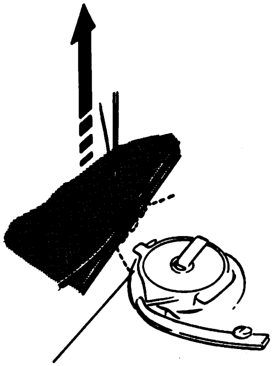

Take-up lever pulls threads up into center of material
Hook makes 2 revolutions for each stitch

Figure 7-1.—(C) The lockstitch. Top and bottom threads centering in material.

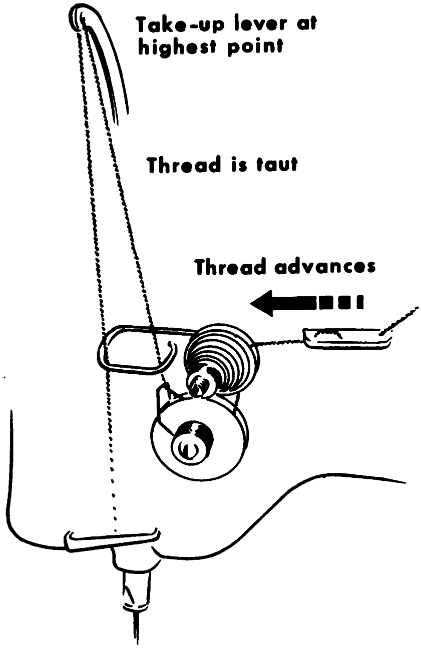


Figure 7-1.—(D) The lockstitch. Top thread advancing for next stitch.

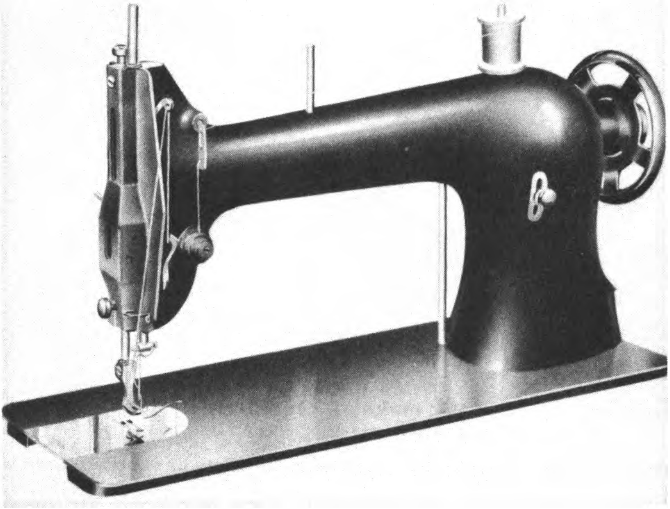


Figure 7–2.—Singer Sewing Machine 31–15.

Lubrication

Oil the machine at oiling points shown in figures 7–3 through 7–5. (Arrows indicate oiling points.) The machine should be oiled frequently when it is in continuous use; twice daily when in constant use.

Oil should be applied regularly to the shuttle bearing in the shuttle race. Occasionally remove the faceplate and apply oil to the bearings and joints that are uncovered.

USE CASTOR BASE OIL, as other mineral base type lubricants tend to gum the machine. Check and follow the manufacturer's recommendations.

Needles

Needles for the 31–15 Singer Sewing Machine, when used on a power table, are of class and variety 16 x 87. Needles

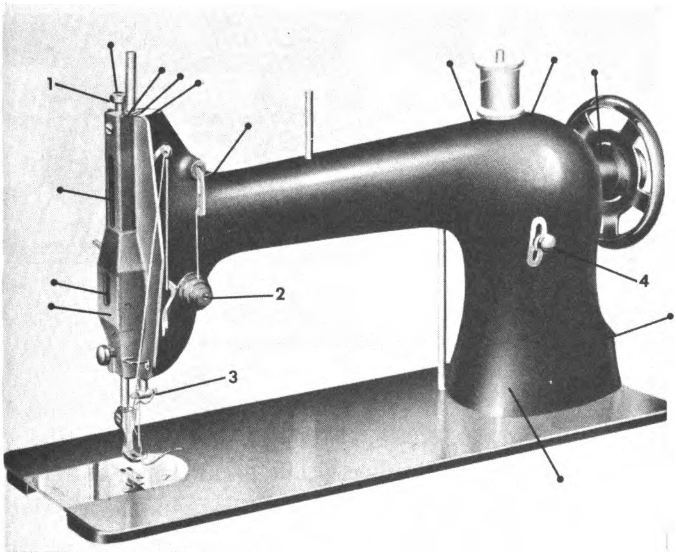


Figure 7–3.—Oiling points at the front of the machine.

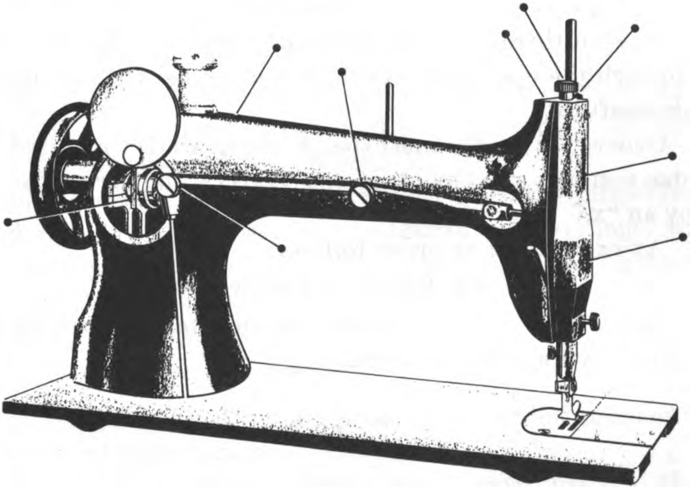


Figure 7–4.—Oiling points at the back of the machine.

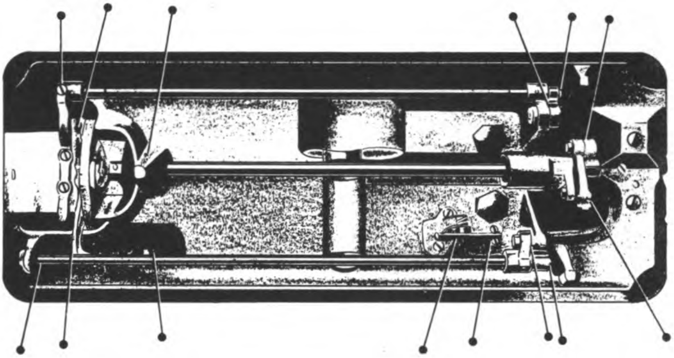


Figure 7–5.—Oiling points in the base of the machine.

are available in various sizes and any of the following sizes may be used: 14, 16, 17, 18, 19, 20, 22, and 23. Needles vary in size according to number. The smaller the number the smaller the needle diameter; and the larger the number the larger the needle diameter. Needles do not vary in length within the same class and variety.

The size of the needle to be used should be determined by the size of the thread, which must pass freely through the eye of the needle and the material to be sewed. If rough or uneven thread is used or if the thread is difficult to pass through the eye of the needle, the machine will not operate successfully.

Orders for needles must specify the QUANTITY required, the SIZE number, and the CLASS and VARIETY numbers separated by an "x."

An example of an order follows:

100 No. 18, 16 x 87 needles.

The best results will be obtained in using the needles furnished by the manufacturer.

Table 7–1.—Relative sizes of needles and thread.

Sizes of needles	Cotton thread	Nylon thread size
18	24 x 4	A and B.
19	24 x 4	C.
20	24 x 4	E.
22	16 x 4	E.

For an enlarged view of a needle used in an oscillating type sewing machine see figure 7–6.

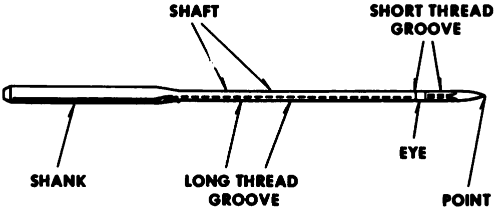


Figure 7–6.—Sewing machine needle adaptable to the 31–15 sewing machine.

Thread

Left twist thread (also known as Z twist (ASO Catalog)) should be used in the needle. Either right or left twist thread can be used in the bobbin.

Hold thread as shown in figure 7–7. Turn the thread toward you, holding it between the thumb and forefinger of the right hand; if left twist, the strands will wind tighter; if right twist, the strands will unwind.

Operation

The following practices and procedures will insure smooth operation of the machine:

1. The balance wheel must always turn toward the operator.

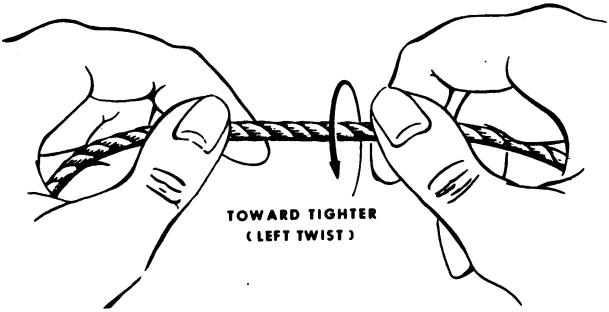


Figure 7–7.—How to determine the twist.

2. Do not run the machine with the presser foot resting on the feed dog without material being under the presser foot.
3. Do not run the machine when both bobbin case and needle are threaded unless there is material under the presser foot.
4. Do not try to help the machine by pulling the material. You may bend or break the needle. If properly adjusted, the machine feeds the work without assistance.
5. The slide over the bobbin case should be kept closed when the machine is in operation.

Safety precautions.—In the interest of safety, practice the following precautions:

1. Keep your head away from the takeup lever.
2. When running the machine do not take your eyes away from the needle and presser foot.
3. Keep your fingers from under the needle.

Thread stand.—The dual spool platform is mounted on a power table and is used to hold large commercial type threads and cords. Wire guides (A, fig. 7–8) should be adjusted directly over the center of the spool for even tension.

This type stand is used on all single needle industrial sewing machines.

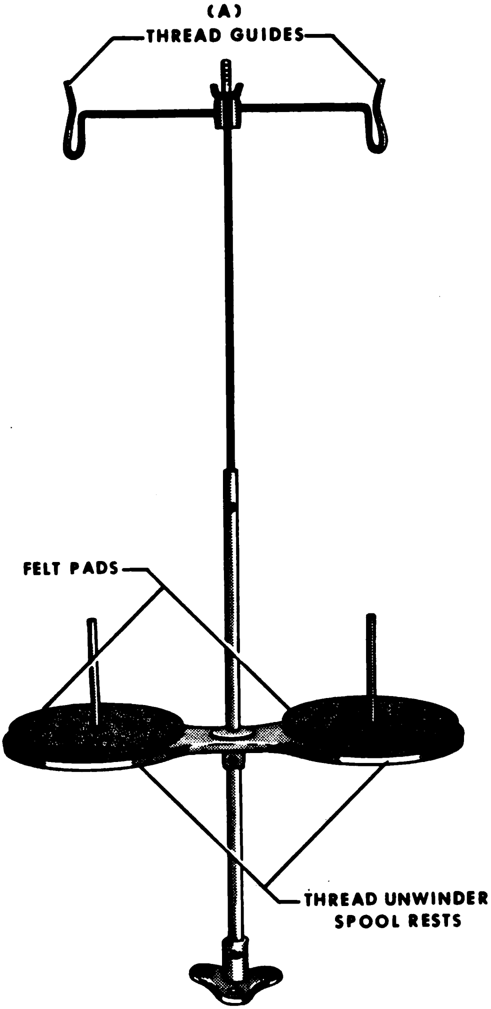


Figure 7–8.—Thread stand.

To SET THE NEEDLE.—Turn the balance wheel toward you until the needle bar moves upward to its highest point; loosen the screw (see fig. 7–3) in the needle clamp; insert the needle ALL THE WAY into the needle bar so that the long groove of the needle is toward the left and the eye of the needle is directly in line with the arm of the machine; then retighten the screw.

To THREAD THE MACHINE (fig. 7–9).—Pass the thread from the thread stand to the thread post (right to left through the bottom hole then right to left through the top hole) or from the spool pin at the right on the top of the machine from right to left through the top hole (1), in the thread retainer, from left to right through the middle hole (2), in the thread retainer, and from right to left through the bottom hole (3), in the thread retainer, down and under from right to left between the tension disks (4), into the thread takeup spring (5), drawing the thread up and beyond the spring end so that it comes out in the center of the spring, under the tension thread guard (6), up and from right to left through the hole in the end of the thread takeup lever (7), down through the thread guide (8), down through the thread guide (9), into the thread guide (10), and from left to right through the eye of the needle (11). Draw about two inches of thread through the eye of the needle with which to commence sewing.

To REMOVE THE BOBBIN.—Turn the balance wheel toward you until the needle moves upward to its highest point. Draw out the slide in the bed of the machine for visibility, reach down under the table and with the thumb and forefinger of the left hand open the bobbin case latch (fig. 7–10) and lift out the bobbin case. While the latch remains open, the bobbin is retained in the bobbin case. Release the latch, turn the open end of the bobbin case down, and the bobbin will drop out.

To WIND THE BOBBIN (fig. 7–11).—Fasten the bobbin winder to the table with its driving pulley in front of the

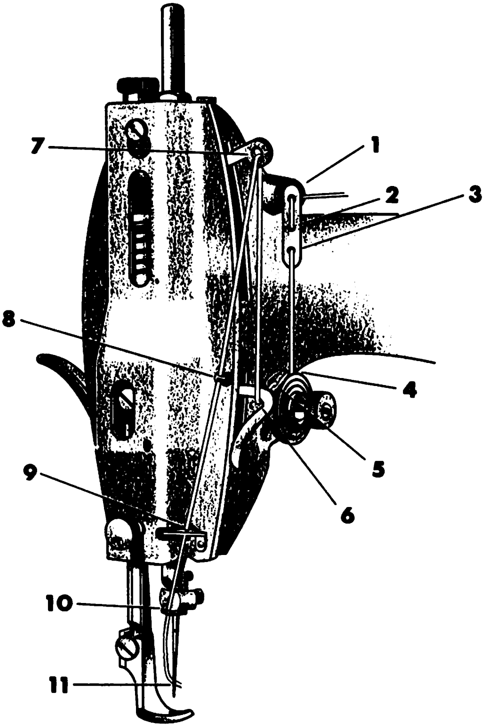


Figure 7–9.—Threading the machine.

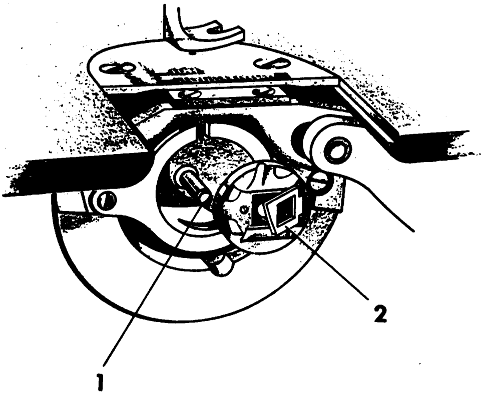


Figure 7–10.—Removing the bobbin case.

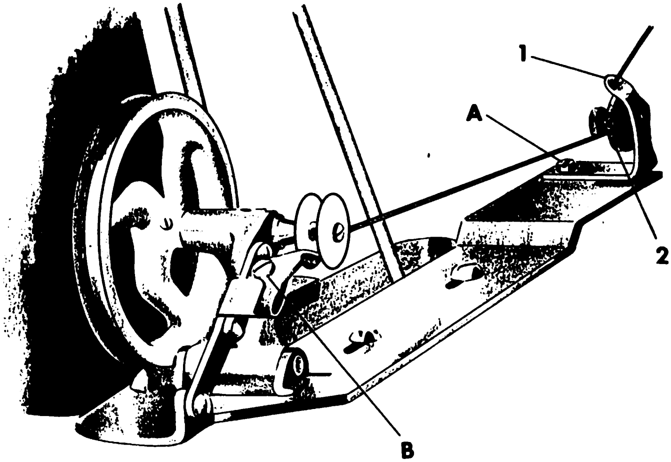


Figure 7–11.—Winding the bobbin.

machine belt, so that the pulley will drop away from the belt when sufficient thread has been wound on the bobbin.

Place the bobbin on the bobbin winder spindle and push it on as far as it will go. Pass the thread down through the thread guide (1) in the tension bracket, around the back and between the tension disks (2). Then wind the end of the thread around the bobbin a few times, push the bobbin winder pulley over against the machine belt, and start the machine.

When sufficient thread has been wound on the bobbin, the bobbin will stop automatically. If the thread does not wind evenly on the bobbin, loosen the screw (A) in the tension bracket and move the bracket to the right or left as required; then tighten the screw.

The amount of thread wound upon the bobbin is regulated by the screw (B). To wind more thread on the bobbin turn the screw to the left. To wind less thread on the bobbin, turn this screw to the right.

Bobbins can be wound while the machine is stitching.

Threading the bobbin case (fig. 7–12).—Hold the bobbin between the thumb and forefinger of the right hand, drawing the thread on top from the left toward the right (view (A)).

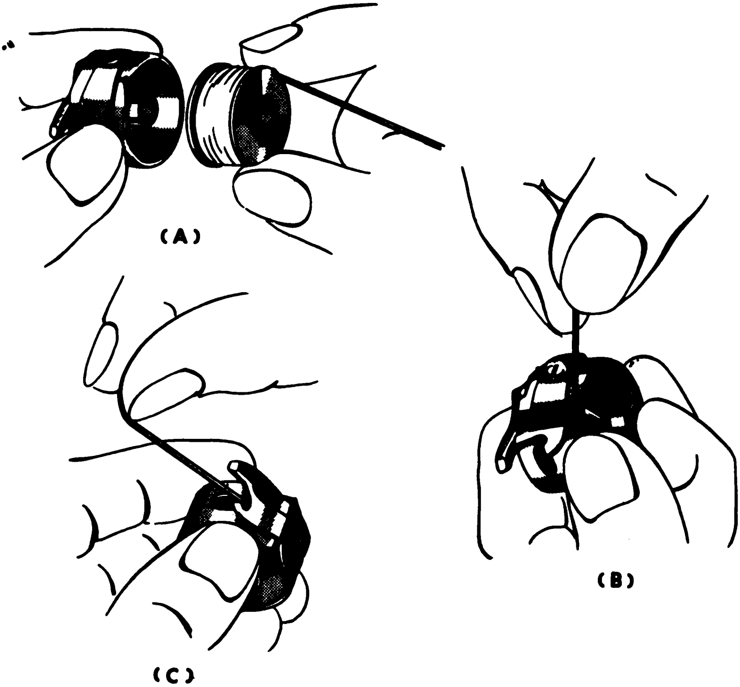


Figure 7–12.—To thread the bobbin case.

With the left hand hold the bobbin case as previously shown with the thread slot in the edge near the top.

Place the bobbin into the bobbin case, then pull the thread into the slot in the edge of the bobbin case (view (B)). Draw the thread down under the tension spring and into the delivery eye at the end of the tension spring (view (C)).

Replacing the bobbin case.—After threading the bobbin case take it by the latch and hold it between the thumb and forefinger of the left hand. Place the bobbin case on the center stud (1, fig. 7–10) of the shuttle body with the position finger opposite the notch at the top of the shuttle race. Then release the latch and press the bobbin case back until the latch catches the groove near the end of the stud. (See fig. 7–13.) Allow about two inches of thread to hang free.

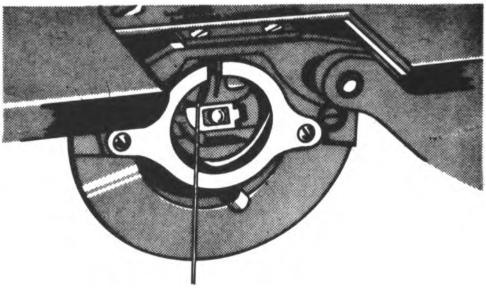


Figure 7–13.—Bobbin case threaded and replaced.

REGULATING THE LENGTH OF STITCH.—The length of stitch is regulated by the thumbscrew (4, fig. 7–3) in the slot on the front of the upright part of the arm. To LENGTHEN the stitch, loosen the thumbscrew and move it DOWN. To SHORTEN the stitch, loosen the thumbscrew and move it UP. When the desired length of stitch has been obtained by test running the machine on scrap material, tighten the thumbscrew.

TO PREPARE FOR SEWING.—With the left hand hold the end of the needle thread, leaving it slack from the hand to the needle. Turn the balance wheel over toward you until the needle moves down and up again to its highest point, thus catching the bobbin thread. Then draw the needle thread up and the bobbin thread will come up with it through the hole in the throat plate. (See fig. 7–14.)

With the thread takeup lever at its highest position lay both threads back under the presser foot.

TO COMMENCE SEWING.—Place the material under the presser foot. Lower the presser foot by hand or knee lift, whichever is used, and commence to sew. To prevent fouling the needle thread in the bobbin race hold the ends of both threads and make the first two stitches manually turning the balance wheel toward you. Guide the material so it does not slip out from under the presser foot.

REGULATING THE PRESSURE ON MATERIALS.—Pressure on the material is regulated by the thumbscrew (1, fig. 7–3) on the

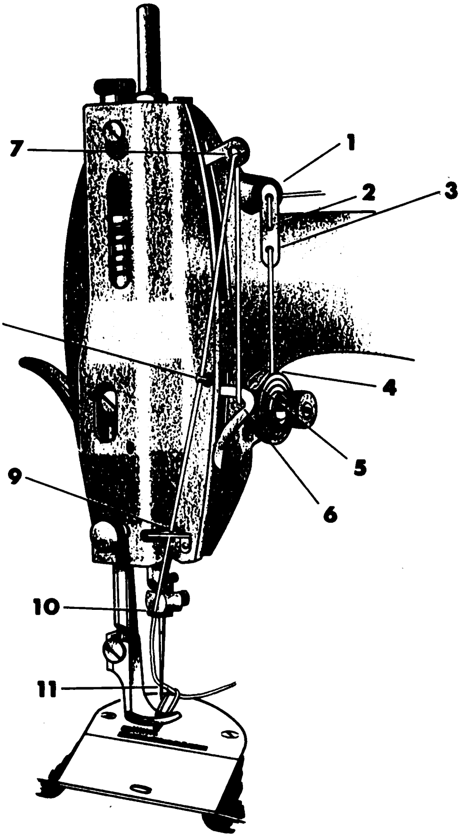


Figure 7–14.—Drawing up the bobbin thread.

top of the machine. To increase the pressure, turn the thumbscrew to the left. The pressure should be just heavy enough to enable the feed to move the work along evenly.

To REGULATE THE TENSIONS.—The thread tensions can be checked at the time the length of stitch is set since a trial run of stitches is necessary during this procedure.

The tension on the needle thread should only be regulated when the presser foot is down. Having lowered the presser foot turn the small nut (2, fig. 7–3) at the front of the tension disks over to the RIGHT TO INCREASE the tension. To decrease THE TENSION, turn the thumb nut over to the left.

The tension on the bobbin thread is regulated by the screw (1, view (B), fig. 7–12) in the bobbin case tension spring. To increase the tension turn the screw to the right. To decrease the tension turn the screw to the left. This screw is very small and is easily lost if extreme care is not exercised in backing it out when decreasing tension. If the screw is tightened excessively or is slightly long, it will penetrate to the inside of the bobbin case and prevent removal of the bobbin.

When the tension on the bobbin thread has once been properly adjusted for a particular size of thread, it is seldom necessary to change it, as a correct stitch can usually be obtained by varying the tension on the needle thread.

For ordinary stitching the needle and bobbin threads should be locked in the center of the thickness of the material. (See fig. 7–15.)

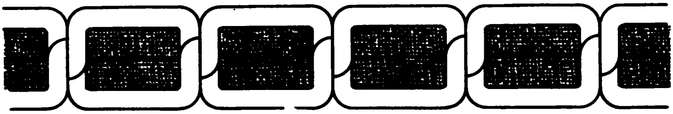


Figure 7–15.—Perfect stitch.

If the tension on the needle thread is too tight, or if the bobbin tension is too loose, the thread will lie straight along the upper surface of the material. (See fig. 7–16.)

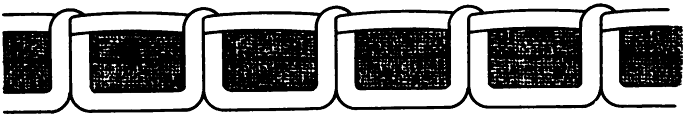


Figure 7–16.—Tight needle thread tension.

If the tension on the bobbin thread is too tight, or if that on the needle thread is too loose, the bobbin thread will lie straight along the underside of the material. (See fig. 7–17.)

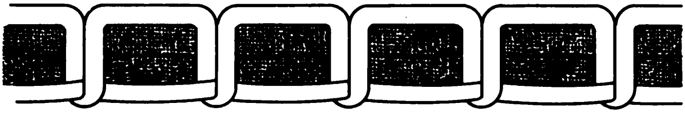


Figure 7–17.—Loose needle thread tension.

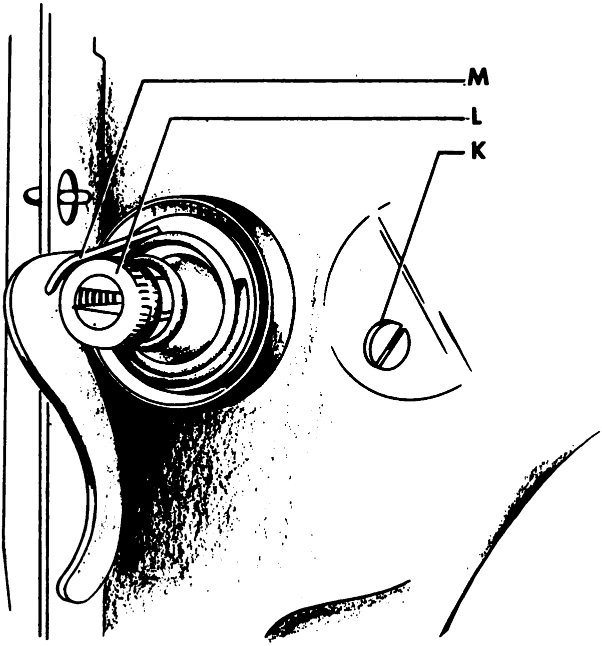


Figure 7–18.—Adjustment of the thread takeup spring.

Removing the work.—Release tension on the foot treadle. Bring the thread takeup lever to its highest point, raise the presser foot, and draw the work and threads out from under the presser foot. Cut the threads close to the material, leaving about two free inches of bobbin and needle thread.

To adjust the thread takeup spring (fig. 7–18).—The thread takeup spring (M) should be set so that when the eye of the needle reaches the material on the downward stroke of the needle bar the spring will be through acting on the thread and will rest against the stop on the thread takeup spring regulator.

If the thread takeup spring is not correctly set, loosen the setscrew (K) in the arm of the machine and turn the tension stud (L) to the right for more movement of the spring, or to the left for less movement. When the spring is correctly set, securely tighten the setscrew (K).

The tension on the thread takeup spring should be just sufficient to take up the slack of the needle thread until the eye of the needle reaches the material in its descent.

To increase the tension on the thread takeup spring (M) loosen the tension screw stud (L) and move the takeup spring from the recess in the regulator to the right between the regulator and the tension disks. When the required tension is obtained, securely tighten the tension screw stud and move the spring back into its position in the regulator recess. To decrease the tension, force the spring to the left between the regulator and the tension disks.

Timing and Adjusting

SETTING THE NEEDLE BAR (fig. 7–19).—See that the needle is pushed up into the needle clamp as far as it will go.

Turn the balance wheel toward you until the point of the shuttle reaches the center of the needle on the upward stroke of the needle bar.

When the shuttle is in this position, the needle bar should have risen $\frac{1}{10}$ of an inch and the top of the eye of the needle should be $\frac{1}{16}$ of an inch below the point of the shuttle (D).

If the eye of the needle is not the correct distance below the point of the shuttle, loosen the screw (C) in the needle bar connecting stud and move the needle bar up or down, as may be required; then securely tighten the screw.

ALWAYS TURN THE BALANCE WHEEL OF THE MACHINE BY HAND BEFORE APPLYING POWER. Follow this rule after making adjustments and whenever approaching an unfamiliar machine.

TO RAISE OR LOWER THE FEED DOG (fig. 7–20).—The feed lifting rockshaft crank (F) should be set so that it raises the

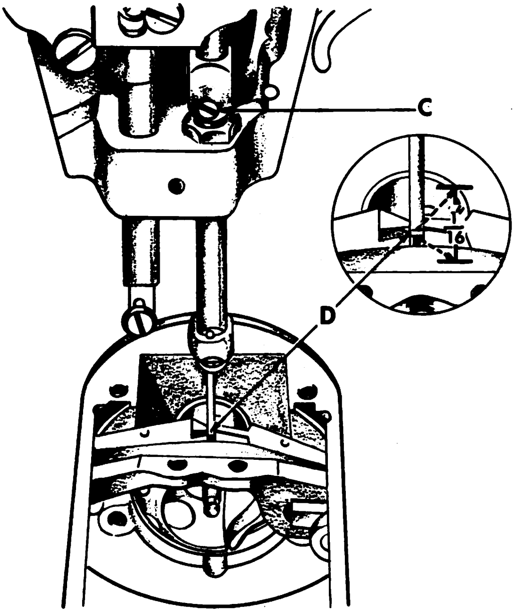


Figure 7–19.—Needle and shuttle point correctly timed.

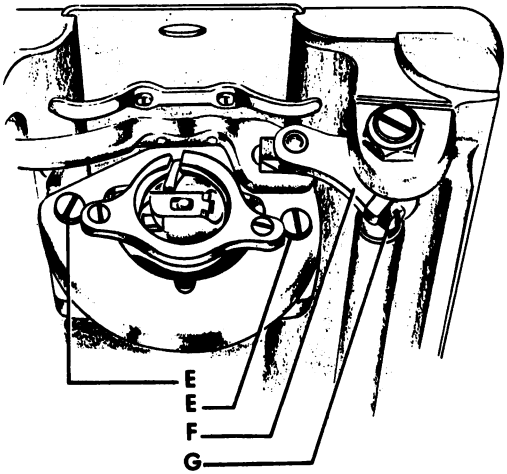


Figure 7–20.—Adjustment for raising and lowering the feed dog.

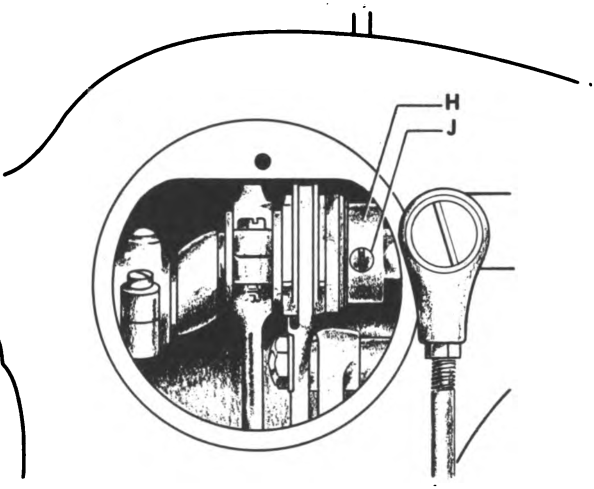


Figure 7–21.—Adjustment for timing feeding mechanism.

feed bar to its highest point, slightly less than the full depth of the teeth which project through the slots in the throat plate. To raise or lower the feed dog, loosen the clamping screw (G) and move the feed lifting rockshaft crank (F) until the feed dog is set at the required height; then securely tighten the clamping screw (G). To replace the shuttle race, remove the two screws (E).

To TIME THE FEED DRIVING ECCENTRIC.—The feeding mechanism located on the arm shaft should be timed so that the feed dog finishes its feeding movement (away from the operator) when the thread TAKEUP LEVER is at its HIGHEST POINT. The feed dog should always finish its feeding movement before the needle reaches the material on its downward stroke.

When it is necessary to time the feeding mechanism, move the stitch regulator (4, fig. 7–3) down to its lowest point for the longest stitch and turn up the round cover plate at the back of the machine. Loosen the feed eccentric setscrew (J, fig. 7–21) and turn the feed eccentric (H, fig. 7–21) until the feed is correctly timed as instructed; then securely tighten the setscrew.

CLASS 7–31 SINGER SEWING MACHINE

The class 7–31 machine is a lockstitch heavy duty machine and is intended for use in sewing heavy canvas, webbings, and other material not adaptable to the lighter duty machines. (See fig. 7–22.)

During operation, the balance wheel should always turn toward the operator.

Oil the machines at all oiling points shown in figures 7–23 and 7–24. Oil frequently, twice daily when in constant use. Use a castor base oil recommended by the manufacturer.

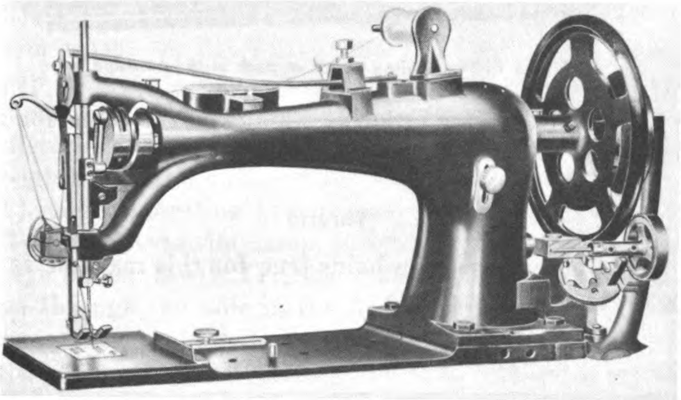


Figure 7–22.—Class 7–31 Singer Sewing Machine.

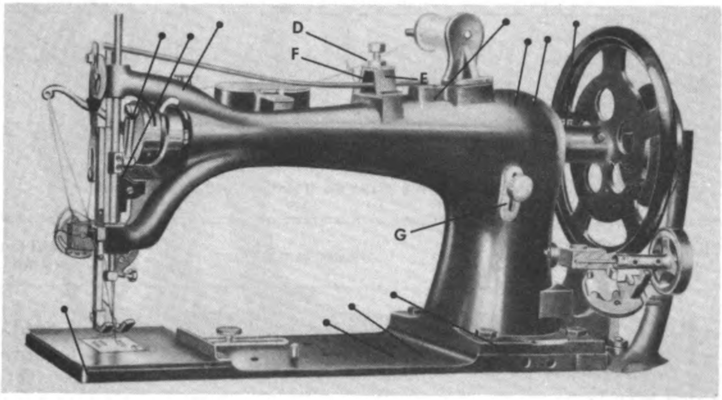


Figure 7–23.—Oiling points at front of the machine.

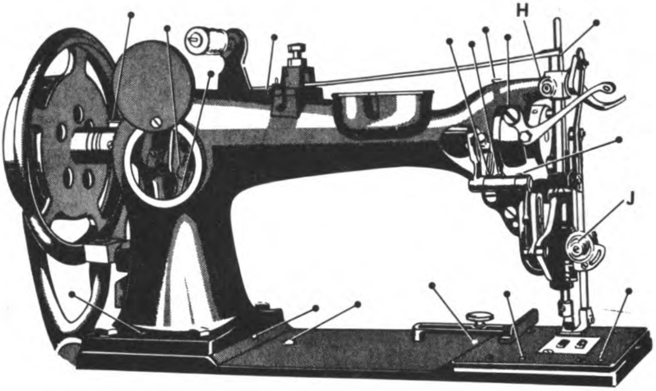


Figure 7-24.—Oiling points at back of the machine.

The procedure for ordering needles is the same for this machine as for the 31-15 sewing machine.

Thread

The same information holds true for this machine as for the 31-15 sewing machine.

Table 7-2.—Needles.

Machines	Class and variety	Description	Sizes
7-31	7 x 1	For fabrics	19, 21, 22, 23, 24, 25, 26, 27.
7-33	7 x 5	For fabrics	28, 29, 30, 31.

Table 7-3.—Relative sizes of needles and thread.

Class and variety	Sizes of needles	Classes of work	Thread and cord size
7 x 1	24	Medium to heavy canvas	3-cord.
7 x 5	28	Heavy canvas and webbing	6-cord.

To SET THE NEEDLE.—The same procedure may be followed with this machine as for the 31–15 sewing machine.

To THREAD THE NEEDLE.—Turn the balance wheel toward you until the thread takeup lever (7, fig. 7–25) moves up to its highest position. Pass the thread from the unwinder, or thread stand to the thread post (right to left through the bottom hole then right to left through the top hole) through the thread guide (1, fig. 7–25) pass the thread through the second thread guide (2, fig. 7–25) over from right to left, continue passage between the thread retainer disks (3, fig. 7–25), down and under and from right to left around the tension wheel (4, fig. 7–25), into the loop of the thread takeup spring (5, fig. 7–25), under the wire loop (6, figs. 7–25 and 7–26), up and from back to front through the hole (7, figs. 7–25 and 7–26) in the thread takeup lever, down through the thread guide (8, fig. 7–26), into the slot (9, fig. 7–26) in the vibrating presser bar, into thread guide (10, fig. 7–26) on the needle clamp, and from left to right through the eye of the needle (11, fig. 7–26), then pass the thread down through the hole in the lifting presser foot (12, fig. 7–26). Draw about four inches of thread through the hole in the lifting presser foot with which to commence sewing.

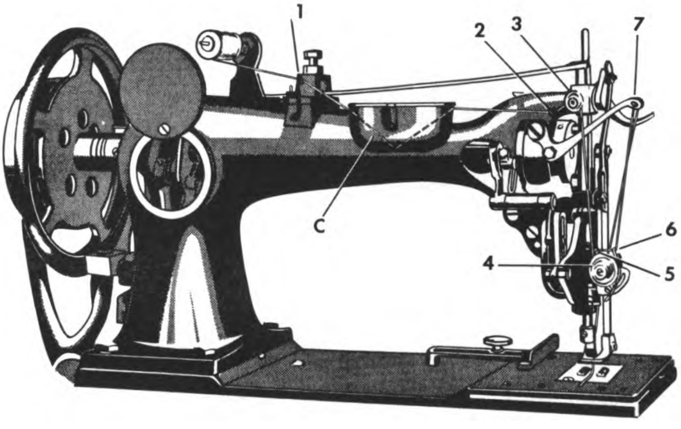


Figure 7–25.—Threading the needle—7–31 sewing machine, (view (A)).

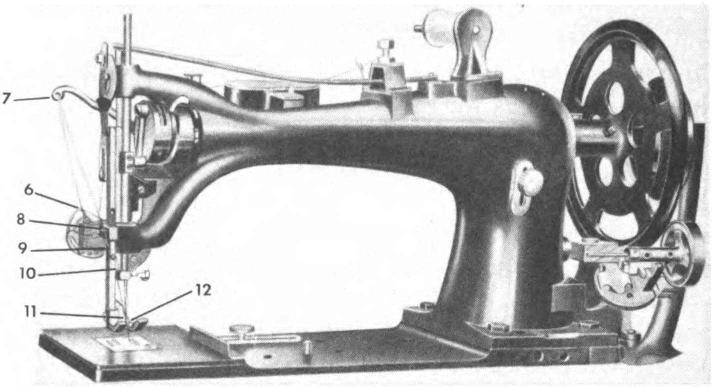


Figure 7–26.—Threading the needle—7–31 sewing machine, (view (B)).

Note that the lubricating cup (C, fig. 7–25) has been bypassed. No LUBRICANT is used to oil the threads and cords used in the manufacture or the repair of parachutes.

To REMOVE THE BOBBIN (fig. 7–27).—Turn the balance wheel to bring the needle bar to its lowest position; then

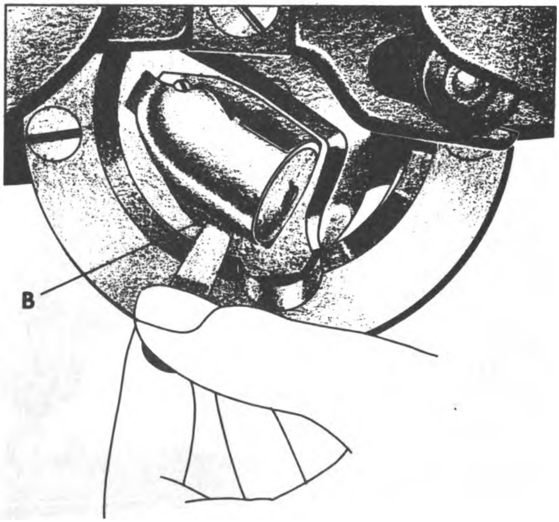


Figure 7–27.—Removing the bobbin.

with the aid of a shuttle opening tool or a small screwdriver, insert the blade end in the slot (B) in the spring latch beneath the shuttle cylinder. Press the latch away from the cylinder outward or toward the left as far as it will go, and the bobbin will drop out.

To WIND THE BOBBIN.—Place the bobbin on the bobbin winder spindle and push it up closely against the shoulder, having the small pin in the shoulder enter the slot in the bobbin.

Pass the thread from the thread stand through the hole in the left side of the bobbin from the inside. Push the bobbin winder pulley up against the balance wheel and place the bobbin winder latch in position as shown in figure 7–28.

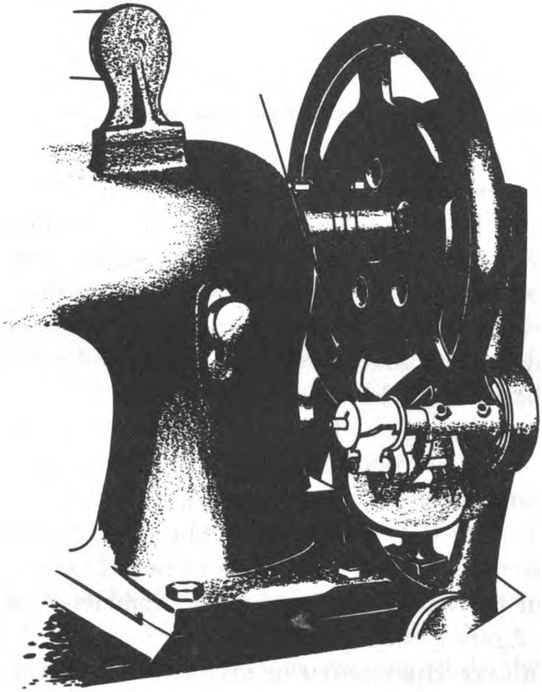


Figure 7–28.—Winding the bobbin.

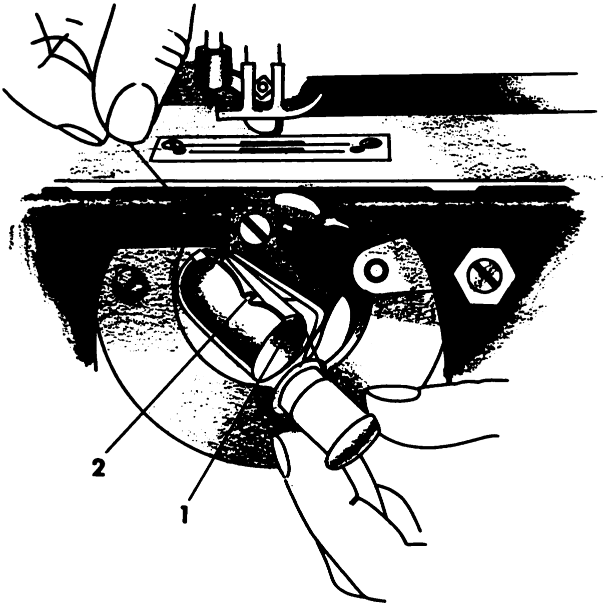


Figure 7–29.—Replacing the bobbin and threading the shuttle.

Raise the presser foot and start the machine. The end of the thread must be held until a few turns are wound and then should be cut off. When sufficient thread has been wound on the bobbin, the bobbin winder will stop automatically.

To REPLACE THE BOBBIN AND THREAD THE SHUTTLE (fig. 7–29).—Take the bobbin between the thumb and forefinger on the left hand, with the thread drawing off from the underside toward the right. Place the bobbin in the cylinder as far as it will go, draw the thread into the slot (1) in the cylinder and under the tension spring into the delivery eye (2); then push the cylinder back until it is locked by the spring latch and allow about three inches of thread to hang free from the shuttle with which to commence sewing as shown in figure 7–30.

To REGULATE THE LENGTH OF STITCH.—Same procedure as for the 31–15 sewing machine.

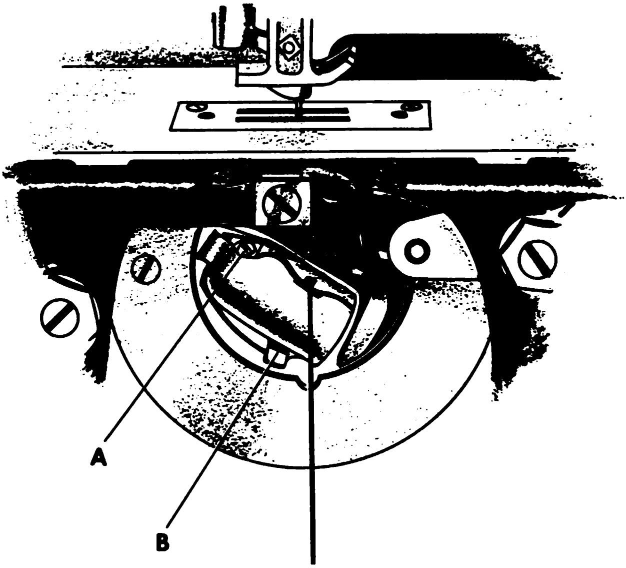


Figure 7–30.—Bobbin replaced and shuttle threaded.

To PREPARE FOR SEWING.—Same procedure as for the 31–15 sewing machine except there is no knee lifting device. The presser bar lifter is the only device provided for lifting the presser foot on the class 7–31 sewing machine.

To REMOVE THE WORK.—Stop the machine with the thread takeup lever resting at its highest position, draw about three inches of thread through the thread retaining disks, raise the presser foot, draw the work back and cut the threads close to the material. Leave the ends of the threads under the presser foot.

To REGULATE THE PRESSURE ON THE MATERIAL (fig. 7–23).—The pressure on the material is regulated by means of the hexagon head screw (D). Loosen the hexagon head locknut (E) and turn the screw (D) to the right to increase the pressure or to the left to decrease the pressure. When the desired pressure has been obtained, hold the screw (D) with a wrench to keep it from turning while the locknut (E) is being tightened against the bracket (F).

The pressure should be just heavy enough to enable the feed to move the work along evenly, and to prevent the work from rising with the needle.

To REGULATE THE TENSIONS (fig. 7–24).—The tension on the needle thread is regulated by the thumb nut (H) at the front of the thread retainer disks, and the thumb nut (J) at the front of the tension wheel. The tension on the thread retainer disks should be just enough to cause the tension wheel to turn when the thread is taken from the spool.

The tension on the bobbin thread is regulated by the screw (A, fig. 7–30), which holds the tension spring to the cylinder. To increase the tension, turn the screw to the right. To decrease the tension, turn the screw to the left.

Timing and Adjusting

Same procedure as outlined for the 31–15 sewing machine.

MODIFICATION OF PRESSER FOOT FOR WEBBING SEWING.—Study figure 7–31 for modification. The presser foot should be cut along the dotted line removing the right portion of

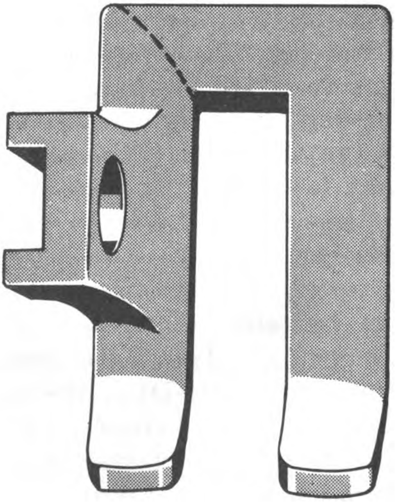


Figure 7–31.—Modification of presser foot for webbing sewing.

the foot. Parachute harness and webbing sewing is classified as a major repair. However, there are various other sewing projects requiring webbing sewing; namely, slings, bridles for tow targets, and nylon barrier repairs.

SEWING MACHINE 111 W 150

The 111 W 150 sewing machine is a HIGH-SPEED, SINGLE NEEDLE LOCKSTITCH, COMPOUND FEED MACHINE employing a BELT DRIVEN ROTARY HOOK with a VERTICAL AXIS. The machine has ball bearings on the upper and lower shafts and in the hook saddle. It is designed for stitching medium weight fabrics such as the kinds used in flight clothing, all nylon cloth sewing, and lightweight canvas up to 12 ounces.

When the machine is in operation the BALANCE WHEEL TURNS OVER TOWARD the operator.

Study figures 7–32 through 7–36 for the oiling points of the 111 W 150 sewing machine. As in the others, some oiling points are duplicated in several views of the machine.

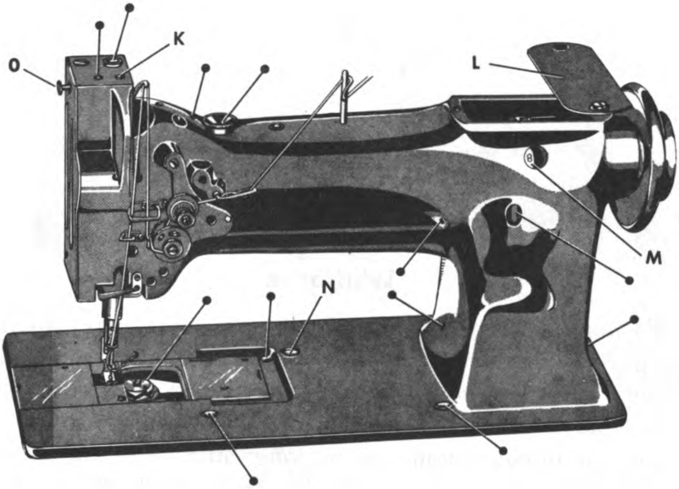


Figure 7–32.—Oiling points of the 111 W 150. Front of the machine.

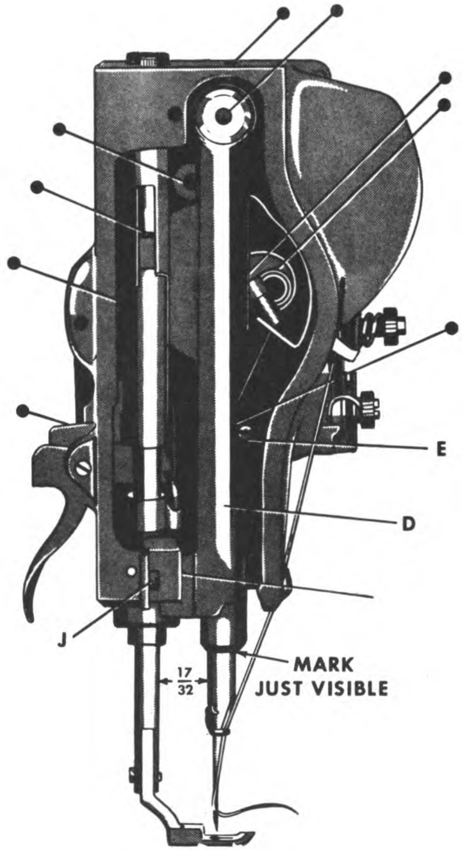


Figure 7–33.—Oiling points of the 111 W 150. End view.

Lubrication

To insure easy running and prevent unnecessary wear of the parts which are in moving contact, the machine requires oiling. When in continuous use, it should be oiled at least twice a day. A new machine should be oiled more frequently when it is in continuous use on long runs. Use one drop of a castor base oil at each oiling point. Wipe off excess oil. The lubricating felt pads are designed to retain a certain amount of oil so do not overlubricate or the oil will stain the material.

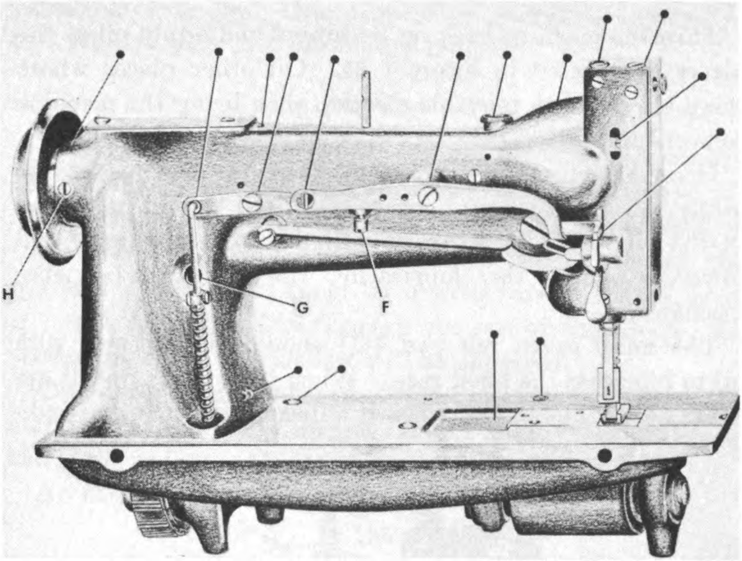


Figure 7–34.—Oiling points of the 111 W 150. Rear view.

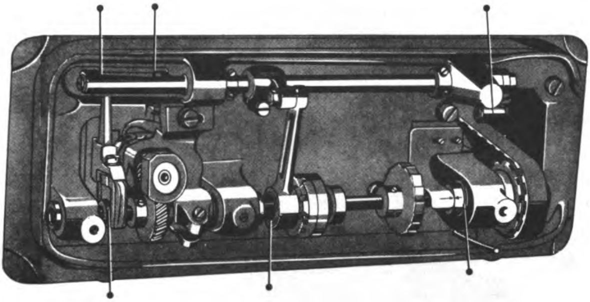


Figure 7–35.—Oiling points of the 111 W 150. Base view.

Oil should be applied at the places designated by arrows as shown in figures 7–32, 7–33, 7–34, 7–35, and 7–36. Swing back the cover (L, fig. 7–32) and oil the bearings which are uncovered; then replace the cover.

Loosen the thumbscrew (O, fig. 7–32) in the upper end of the faceplate, and turn the faceplate upward in order to oil the wick and bearings shown in figure 7–33; then replace the faceplate.

Turn the machine back on its hinges and apply oil at the places designated in figure 7-35. Oil other places where there are parts in movable contact, then bring the machine forward into place.

Hook lubrication.—Figure 7-36 shows the means for oiling the ball bearing hook saddle. Oil should be placed in the oil well (P) where it will flow to both upper and lower bearings, also lubricating the mechanical opener mechanism.

The small green felt pad (Q) should be kept wet with oil to lubricate the hook race. When this pad is wet, it appears nearly black; and when it appears light green, it indi-

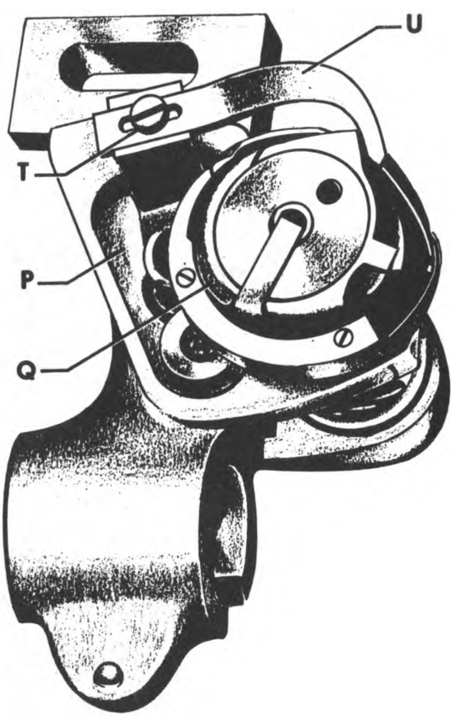


Figure 7-36.—Sewing machine 111 W 150 nomenclature and hook lubrication points.

cates that it is dry. One drop of oil should be applied to this felt pad each time a bobbin is replaced.

Needles

Needles for machine 111 W 150 are of class and variety 135 x 7, made in sizes 7, 8, 9, 10, 12, 14, 16, 18, 20, 22, and 24.

The size of the needle to be used should be determined by the size of the thread which must pass freely through the eye of the needle. If rough or uneven thread is used, or if it passes with difficulty through the eye of the needle, the successful use of the machine will be impaired.

Orders for needles must specify the QUANTITY required, the SIZE number, and the CLASS and VARIETY numbers separated by the letter "x."

An example of an order follows:

100 No. 14, 135 x 7 needles.

For an enlarged view of a needle used in a rotary type sewing machine see figure 7–37.

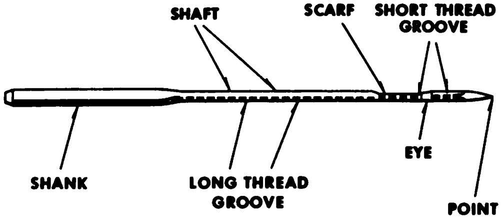


Figure 7–37.—Sewing machine needle used in a rotary type sewing machine.

NOTE: Machine needle class and variety 135 x 7 designed for the 111 W 150 may be used on the 31–15 in emergencies, but since the 31–15 needle, class and variety 16 x 87, has no scarf it can not be used in the 111 W 150 sewing machine.

Thread

Use left twist thread for the needle. Either left or right twist thread may be used for the bobbin. Determine the twist as previously illustrated.

Table 7–4.—Relative sizes of needles and thread.

Sizes of needles	Cotton thread	Nylon thread size
18	24 x 4	A, B, C.
20	24 x 4	E.

Operation

To SET THE NEEDLE.—Turn the balance wheel over toward you until the needle bar moves up to its highest point, loosen the setscrew in the needle bar and put the needle up into the bar as far as it will go. The needle's long groove should be toward the left, with the eye of the needle being directly in line with the machine bed. Then tighten the setscrew.

THREADING THE MACHINE (fig. 7–38).—To thread the machine pass the thread from the unwinder from back to front through the lower hole (1), in the thread post on top of the machine and from right to left through the upper hole (2) in the post, down through the hole (3), up through the hole (4), and down through the hole (5), in the thread guide at the front of the machine, over from right to left between the tension disks (6), down and under from right to left around the thread controller (7), into the thread controller spring, drawing the thread back past the guide point (8 A) visible in the small window in the thread controller (7), up through the thread guide (9), from right to left through the hole (10), in the thread takeup lever, down through the thread guide (11), and through the thread guides (12 and 13), through the thread guide (14) at the bottom of the needle bar, and from left to right through the eye of the needle (15). A good general rule to remember is ALWAYS THREAD THE NEEDLE TOWARD THE BOBBIN.

To REMOVE THE BOBBIN.—Draw out the slide plate in the bed of the machine. Insert the fingernail of the forefinger under the latch (C, fig. 7–39), raise the latch, and lift out the bobbin.

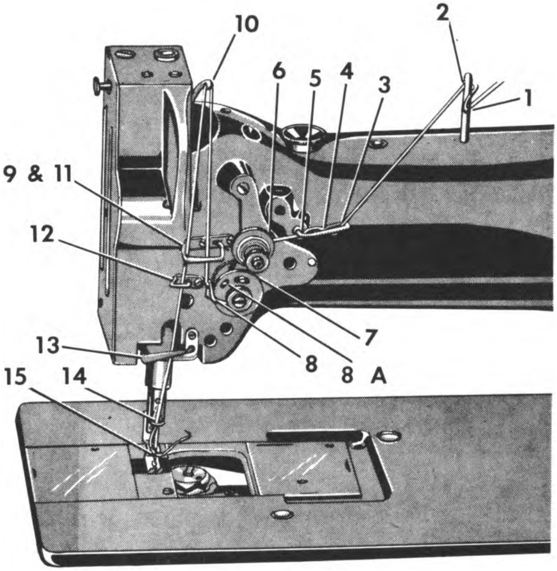


Figure 7–38.—Threading the machine.

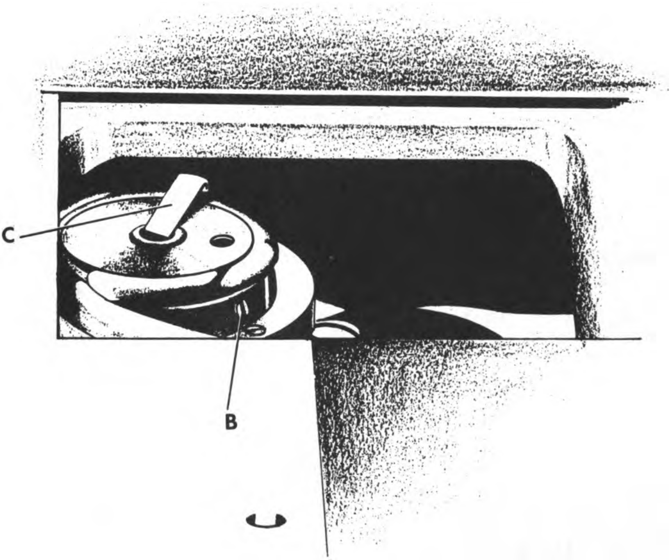


Figure 7–39.—Removing the bobbin.

To WIND THE BOBBIN.—Follow the same procedure as outlined for the 31–15 sewing machine.

To REPLACE THE BOBBIN AND THREAD THE BOBBIN CASE.—Hold the bobbin between the thumb and forefinger of the right hand, the thread drawing off on the bottom from left to right as shown in figure 7–40.

Place the bobbin on the center stud of the bobbin case (fig. 7–41), then push down the latch (C). Draw the thread into the slot (1) and under the back of the projection (2), leaving a loose end of thread about two inches long above the slide. When closing the slide plate, leave just enough space for the thread to pass through.

To REGULATE THE LENGTH OF STITCH (fig. 7–32).—The number of stitches per inch is stamped on the stitch indicating disk (M) located on the arm shaft.

To change the length of stitch, press down the plunger (N) in the bed of the machine and at the same time turn the balance wheel slowly until the plunger enters a notch in the adjustable feed eccentric cam. Still holding the plunger (N), turn the balance wheel over a part of a revolution until the number of the stitches per inch desired can be seen through the hole in the front of the arm (M), then release the plunger (N).

To PREPARE FOR SEWING.—With the left hand hold the end of the needle thread, leaving it slack from the hand to the needle. Turn the balance wheel toward you until the needle moves down and up again to its highest point, thus catching the bobbin thread. Draw up the needle thread and the bobbin thread will come up with it through the hole in the feed dog. Lay the threads back under the presser foot and close the slide.

Starting with the thread takeup lever at its highest point, place the material under the presser foot. Lower the presser foot and commence to sew.

To prevent fouling the needle thread in the bobbin race hold the ends of both threads and make the first two stitches manually turning the balance wheel toward you.

To REGULATE THE PRESSURE ON THE MATERIAL.—The pres-

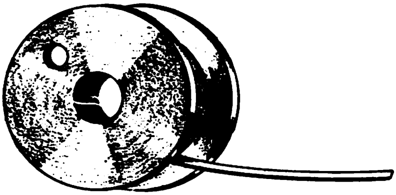


Figure 7–40.—Direction of thread and bobbin.

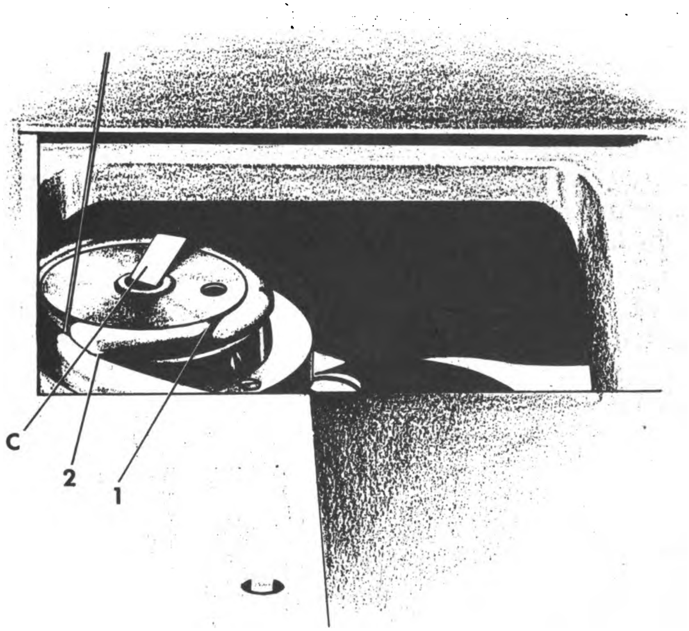


Figure 7–41.—Bobbin case threaded.

sure on the material is regulated by the screw (F, fig. 7–34) at the back of the machine, the screw acting on a flat spring. To increase the pressure, turn the screw DOWN and to the right. To decrease the pressure turn the screw UP and to the left. The pressure should be only heavy enough to enable the feed to move the work along evenly.

TO REGULATE THE TENSIONS.—The needle and bobbin threads should be locked in the center of the thickness of the material.

The tension on the needle thread is regulated by the thumb nut (D, fig. 7-42) at the front of the tension disks on the front of the machine. To increase the tension, turn this thumb nut to the right. To decrease the tension, turn the thumb nut to the left.

The tension on the bobbin thread is regulated by means of the screw nearest the center of the tension spring on the outside of the bobbin case. To increase the tension, turn the screw to the right (B, fig. 7-39).

The tensions should be regulated on a scrap piece of material identical in weave, texture, and numbers of plies to the material to be sewed.

If the tension screw in the bobbin case is tightened excessively it will protrude into the bobbin case and prevent removal of the bobbin. When the bobbin screw is excessively tightened in order to acquire the proper tension, it is an indication that the tension spring is bent, broken, or improperly seated. Passage and tension of the upper thread should be checked also. Always check the tensions for a perfect stitch when sewing from one thickness to another. This holds true for all types of sewing machines. The perfect stitch is illustrated in figure 7-15.

THREAD CONTROLLER (fig. 7-42).—The function of the thread controller is the same for this machine as previously outlined for the 31-15 machine.

For more controller action on the thread, loosen the stop screw (S) at the right of the tension device and set the stop lower. For less action set the stop higher.

To strengthen the action of the controller spring on the thread, loosen the tension stud screw (T) at the right of the stop screw and turn the tension stud (R) slightly to the left with a screwdriver. To lighten its action turn the tension stud to the right and retighten the tension stud screw (T).

TO REMOVE THE WORK.—Have the thread takeup lever at the highest point. Raise the presser foot, draw the work back, and cut the threads close to the material. Lay the ends of the threads back under the presser foot.

SAFETY PRECAUTIONS.—The same safety precautions hold true with this machine as prescribed for the 31-15 machine.

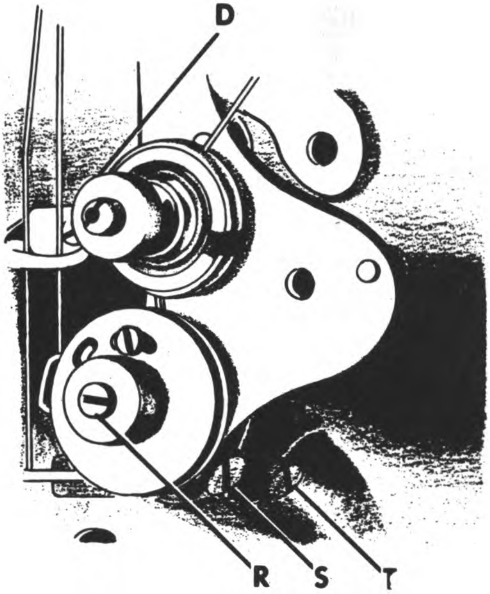


Figure 7–42.—Adjustment to thread controller.

Timing and Adjusting

Before making any timing adjustments, put the machine on zero feed and remove the belt from the balance wheel.

To SET THE NEEDLE BAR (fig. 7–33).—See that the needle is up in the bar as far as it will go. There are two lines across the needle bar about two inches above the lower end. When the needle bar is at its lowest position (the needle bar connecting link will also be in the lowest position) the upper mark should be just visible at the end of the needle bar frame.

In case the needle bar is not correctly set, loosen the needle bar connecting stud pinch screw (E) and place the needle bar in correct position as directed above, then retighten the screw.

To set a needle bar which has no mark, set the feed eccentric so there is no feeding motion, then set the needle bar so that when it rises $3/32$ of an inch from its lowest position and the point of the sewing hook is at the center of the needle, the needle eye will be about $1/16$ of an inch below the hook point.

FORWARD-AND-BACK POSITION OF THE NEEDLE BAR.—The needle bar should be set so that a straight needle is centered in the needle hole in the feed dog (or slightly more toward the operator) throughout their feeding movement. It should also be set so that when the feed eccentric is set for zero feeding movement, the distance between the needle bar and the presser bar will be $17/32$ inch, as shown in figure 7–33.

If the needle bar is not centered correctly in the needle hole in the feed dog, adjust the feed eccentric for zero feeding movement, then loosen the clamp screw in the crank (W, fig. 7–43) and also the screw which is reached through the hole (G, fig. 7–34) in the back of the arm; center the needle with the feed dog, and see that the crank is parallel with the top surface of the bed before tightening the two clamp screws.

If the needle bar is now an improper distance from the presser bar, with zero feeding movement, loosen clamp screw (V, fig. 7–43) and set the needle bar $17/32$ inch from the presser bar; then retighten the screw. The shank of the presser foot is $17/32$ inch wide and may be used as a gage for determining the right distance.

TO TIME THE SEWING HOOK.—Set the feed eccentric so there is no feeding motion.

Remove the throat plate and turn the balance wheel over toward you until the lower mark across the needle bar is just visible at the end of the needle bar frame on the upward stroke of the needle bar. If the needle bar and sewing hook are correctly timed, the point of the hook will be at the center of the needle and about $1/16$ inch above the eye.

In case the sewing hook is not correctly timed, turn the balance wheel over toward you until the needle bar has descended to its lowest point and has risen until the lower timing mark across the needle bar is just visible at the end of the needle bar frame.

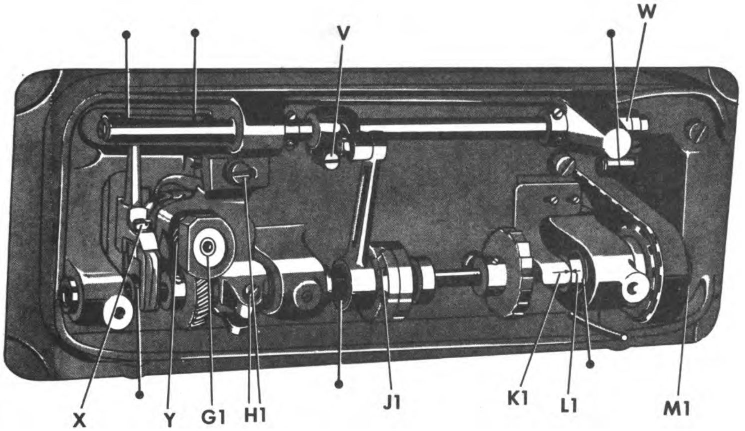


Figure 7–43.—Adjustment of hook saddle.

Loosen the two screws in the hook shaft gear (Y, fig. 7–43) and turn the sewing hook until the point of the hook is at the center of the needle. Then securely tighten the two screws in the gear (Y), leaving just enough play in the shaft for lubricating purposes.

To SET THE SEWING HOOK TO OR FROM THE NEEDLE.—To prevent the point of the hook from dividing the strands of the thread, it should pass as close to the needle (within the scarf) as possible.

Turn the balance wheel toward you until the point of the sewing hook is at the center of the needle. Loosen the two screws (H 1, fig. 7–43) underneath the bed of the machine and move the hook saddle to the right or left, as may be required, until the point of the hook is as close to the needle as possible without striking it; then securely tighten the two screws.

The function of the hook guard washer (needle guard) which is attached to the bottom of the sewing hook, is to prevent the point of the hook from striking the needle if, when passing through the material, the needle is deflected toward the hook.

The needle guard (A, fig. 7–44) can be bent with a small pair of pliers until it prevents the hook point from striking

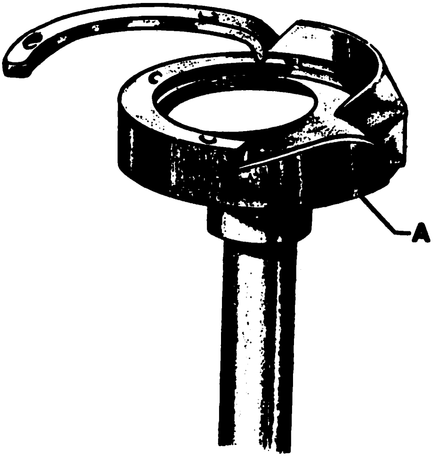


Figure 7–44.—Sewing hook showing needle guard.

the needle, but it should not be bent outward enough to deflect the needle from its normal path.

Caution: When replacing the throat plate be sure the lug on the bobbin case is in the notch on the underside of the throat plate.

To ADJUST THE MECHANICAL OPENER (fig. 7–36).—The bobbin case opener (U) should be set so that it touches the bobbin case as lightly as possible, yet turns the bobbin case enough to make sufficient opening for the free passage of the thread between the throat plate and the bobbin case. The bobbin case opener can be adjusted by loosening the screw (T) and moving the opener (U) as required; then retighten the screw.

To RAISE OR LOWER THE FEED DOG (fig. 7–43).—Usually when the feed dog is at its highest position, it should show a full tooth above the throat plate.

Remove the throat plate; clean the lint and dust from between the feed points and replace the throat plate; tip the machine back and turn the balance wheel towards you until the feed dog is at its highest position; loosen screw (X) in the feed lifting cam fork on the feed bar and raise or lower the feed dog, as may be required, and retighten the screw (X).

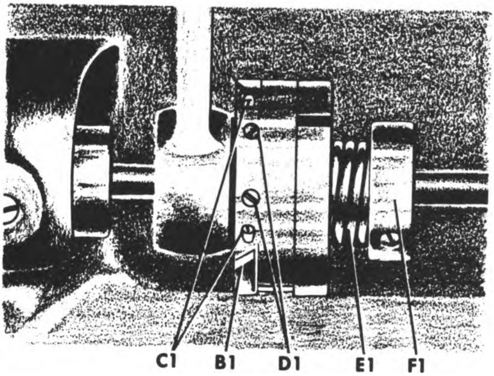


Figure 7–45.—Feed eccentric.

THE FEED ECCENTRIC (fig. 7–45).—The feed eccentric is provided with a gib (B 1) which can be adjusted to take up any wear or loose motion between the feed eccentric and the eccentric body. To adjust the gib loosen the two locking screws (C 1), then turn in the two adjusting screws (D 1) against the gib until all play is eliminated and the eccentric fits snugly in the slot in the eccentric body. Securely tighten the two locking screws (C 1).

The spring (E 1) presses against the feed eccentric cam to prevent it from moving out of position while the machine is operating. The collar (F 1) may be moved to the right or left to change the spring pressure. It should ordinarily be set flush with the end of the hub of the eccentric body.

TO ADJUST THE STITCH LENGTH INDICATOR.—Set the machine to produce eight measured stitches to the inch. Then loosen the setscrew in the stitch indicating disk, (M, fig. 7–32), press down the plunger (N, fig. 7–32) in the bed of the machine and at the same time turn the balance wheel slowly until the plunger enters the notch (J 1, fig. 7–43) in the adjustable feed eccentric cam. With the machine in this position, the stitch indicating disk (M, fig. 7–32) should be set so that the figure "8" can be seen through the hole in the front of the arm, then tighten the setscrew in the stitch indicating disk.

SEWING MACHINE 111 W 155

The 111 W 155 sewing machine is similar to the 111 W 150 sewing machine except that it is designed for heavier work and is equipped with alternating presser feet for more positive feeding action. The positive feeding motion is brought about by the compound action of the alternating pressers, viz: The rear presser holds the material down while the needle and forward presser are not in contact with the material; when the needle and forward presser come in contact with the material, the rear presser rises until the feeding motion of the needle, forward presser, and feed dog is completed.

The machine IS NOT ADAPTABLE TO LIGHT FABRIC WORK as the feeding action of the alternating pressers puckers and damages lightweight fabrics.

Lubrication

TO OIL THE MACHINE.—To insure easy running and prevent unnecessary wear of the parts which are in movable contact, the machine requires frequent oiling. When in continuous use, it should be oiled at least twice each day. Use a lightweight CASTOR BASE OIL.

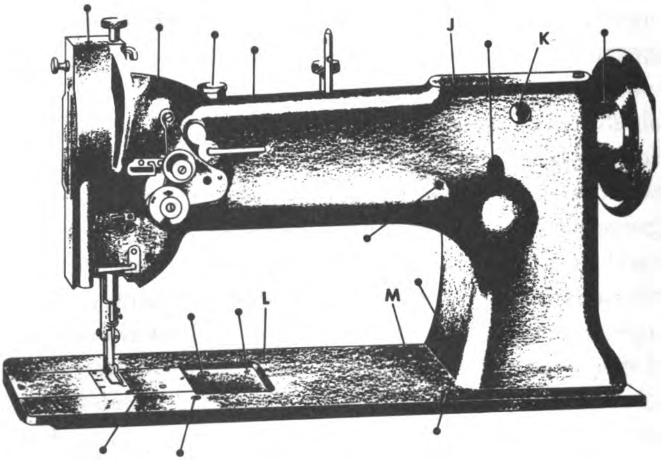


Figure 7—46.—Front of machine showing oiling points and adjustments.

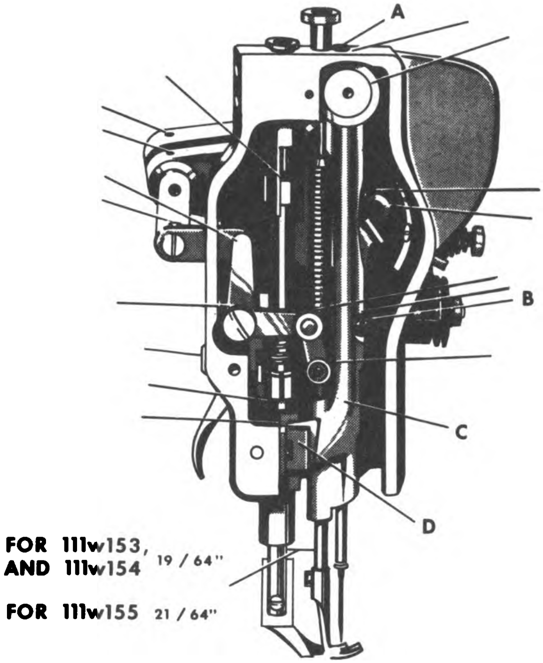


Figure 7–47.—End view of machine showing oiling points and adjustments.

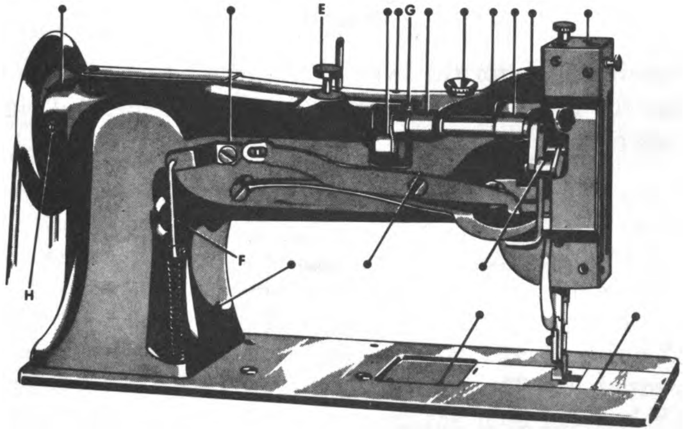


Figure 7–48.—Rear view of machine showing oiling points and adjustments.

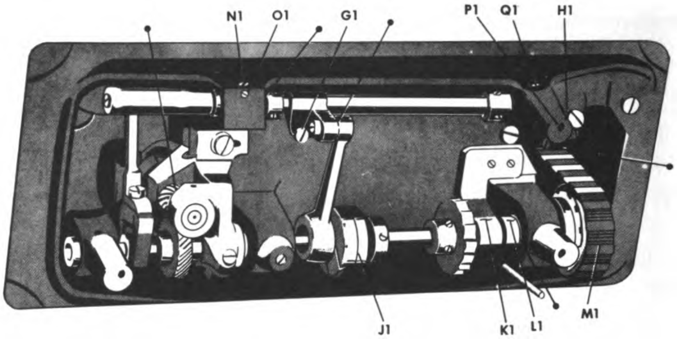


Figure 7–49.—Base of machine showing oiling points and adjustments.

Oil should be applied at the places designated by unmarked arrows in figures 7–46 to 7–49. Swing back the top cover (J, fig. 7–46) and oil the bearings which are thus uncovered; then replace the cover.

Loosen the thumbscrew in the upper end of the faceplate, turn the faceplate upward and oil the wick and contact surfaces of the movable parts shown in figure 7–47; then turn down the faceplate and tighten the thumbscrew.

HOOK LUBRICATION.—Follow the same procedure as previously outlined for the 111 W 150 sewing machine.

Thread

Specifications for the twist of thread are the same for all lockstitch machines; use left twist in the needle, and right or left twist in the bobbin.

Table 7–5.—Relative sizes of needles and thread.

Size of needles	Cotton thread	Nylon thread size
18	24 x 4	A, B, C
20	24 x 4	E
22	16 x 4	E

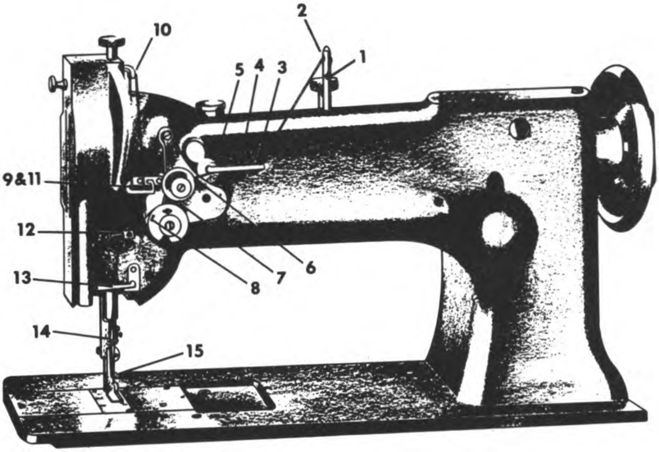


Figure 7-50.—Upper threading. Sewing machine 111 W 155.

Needles

Needles for machine 111 W 155 are of class and variety 135 x 17 which are made in sizes 12, 14, 16, 18, 20, 22, 23, and 24.

Operation

To set the needle.—Follow the same procedure used on the 111 W 150 sewing machine.

Threading the machine (fig. 7-50).—This machine is provided with a thread lubricator which uses a special stainless oil for the purpose of lubricating the needle thread. The purpose of the lubricator is to oil the needle thread so it can easily pass through tough fabrics and leathers, thus preventing numerous thread breakages. The thread lubricator is not necessary for parachute repairs and is not to be used. For parachute repairs, bypass the thread lubricator which in this case may be removed from the pin. Pass the thread from the thread stand from back to front through the lower hole (1) in the thread post on top of the machine and from right to left through the upper hole (2) in the post downward through the hole (3), up through the hole (4) and down through the hole (5) in the thread guide at the front of the machine, over from right to left between the tension disks (6), down under from right to left around the thread controller (7), up into the fork (8) in the thread controller disk against the pressure of the wire controller spring, up through the thread guide (9), from right to left through the hole (10) in the thread takeup lever, down through the thread guides (11, 12, and 13) through the thread guide (14) at the bottom of the needle bar and from left to right through the eye of the needle (15).

OTHER OPERATIONAL STEPS.—The operational steps listed below for the 111 W 155 machine are the same as for the 111 W 150 and are discussed on pages 327 to 341.

Removing the bobbin.
Winding the bobbin.
Replacing and threading the bobbin.
Regulating the length of stitch.
Preparation for sewing.
Regulating the pressure on the material. (Similar but not identical to the 111 W 150. The 111 W 155 is equipped with a thumbscrew (E, fig. 7–48) on top of the spring.)
Regulating the tension.
Thread controller.
Removing the work.

Timing and Adjusting

Before making any timing adjustments put the machine on zero feed and remove the belt from the balance wheel.

TO SET THE NEEDLE BAR.—See that the needle is positioned in the bar as far as it will go.

Follow the same procedure as outlined for the 111 W 150 sewing machine with needle bar timing marks.

To set the needle bar which has no mark, set the feed eccentric for 8 stitches to the inch, and follow the remaining procedure as described for the 111 W 150 sewing machine.

FORWARD-AND-BACK POSITION OF NEEDLE BAR AND VIBRATING PRESSER BAR FRAME.—The needle bar frame (C, fig. 7–47) should be set so that a STRAIGHT NEEDLE is centered in the needle hole in the feed dog or slightly off centered toward the operator throughout their feeding motion. It should also be set so that when the feed eccentric is set for zero feed the distance between the vibrating presser bar and the lifting presser bar will be 21/64 inch as shown in figure 7–47.

If the needle is not centered correctly in the needle hole in the feed dog, adjust the feed eccentric for zero feed, then loosen the clamp screw in the crank (H 1, fig. 7–49) and also the screw reached through the hole (F, fig. 7–48) in the back of the arm. Center the needle with the feed dog and see that the crank (H 1, fig. 7–49) is parallel with the top surface of the bed before tightening the two clamp screws.

If the vibrating presser bar is now the wrong distance from the lifting presser bar, with zero feeding movement, loosen clamp screw (G 1, fig. 7–49) and set the bars 21/64 inch apart, then tighten the clamp screw. A piece of sheet metal 21/64 inch wide may be used as a gage for determining the right distance.

TO ADJUST THE RELATIVE HEIGHT OF LIFT OF THE VIBRATING AND LIFTING PRESSERS.—The amount of lift of the alternating presser feet should be regulated according to the thickness of the material being sewed. The feed should lift just high enough to clear the material. Normally, the feed should lift

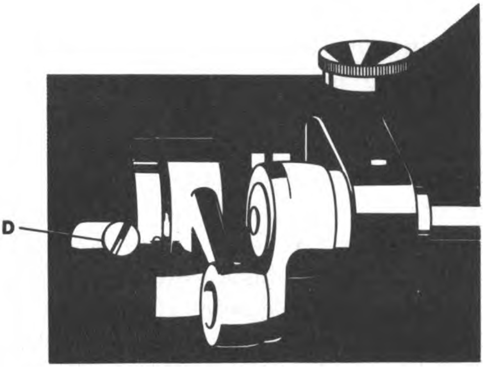


Figure 7–51.—Adjusting the height of lift. Adjusting screw is protruded and visible.

an equal height, but some grades of work may require that they lift an unequal height. To change height of lift of the presser feet, loosen the setscrew (not visible in fig. 7–51) in the lifting eccentric and turn the balance wheel so that the adjusting screw (D, fig. 7–51) is accessible. To increase the amount of lift, turn the screw counterclockwise; to decrease the amount of lift, turn the screw clockwise. Then turn the balance wheel and retighten the recessed setscrew.

To TIME THE SEWING HOOK.—Set the feed eccentric so that there is no feeding motion.

Remove the throat plate and turn the top of the balance wheel toward you until the lower mark across the needle bar is just visible at the end of the needle bar frame on the upward stroke of the needle bar. If the needle bar and sewing hook are correctly timed, the point of the hook will be at the center of the needle and about 1/16 inch above the eye.

In case the sewing hook is not correctly timed, turn the top of the balance wheel toward you until the needle bar has descended to its lowest point and has risen until the lower timing mark across the needle bar is just visible at the end of the needle bar frame.

Loosen the two screws in the hub of the hook driving gear (U, fig. 7–52) and tap this gear to the right on the hook driving shaft for an earlier hook timing, or to the left for a later hook timing. When the correct timing is obtained, securely tighten the two setscrews in the hub of the gear.

To SET THE SEWING HOOK TO OR FROM THE NEEDLE.—To prevent the point of the hook from dividing the strands of the thread, it should pass as close to the needle (within the scarf) as possible.

Turn the top of the balance wheel toward you until the point of the sewing hook is at the center of the needle. Loosen the two screws (W, fig. 7–52) underneath the bed of the machine and move the hook saddle to the right or left, as may be required, until the point of the hook is as close to the needle as possible without striking it; then securely tighten the two screws.

To RAISE OR LOWER THE FEED DOG.—Usually when the feed

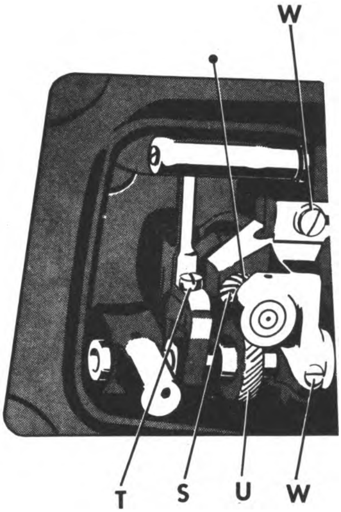


Figure 7–52.—Adjustment of hook saddle.

dog is at its highest position, it should show a full tooth above the throat plate.

Remove the throat plate; clean the lint and dust from between the feed points and replace the throat plate; tip the machine back and turn the balance wheel towards you until the feed dog is at its highest position; loosen screw (T, fig. 7–52) in the feed lifting cam fork on the feed bar and raise or lower the feed dog, as may be required, and retighten the screw.

When raising or lowering the feed dog, be careful that its underside does not drop low enough to strike the sewing hook.

THE FEED ECCENTRIC (fig. 7–53).—The feed eccentric is provided with a gib (B 1) which can be adjusted to take up any wear or loose motion between the feed eccentric and the eccentric body. To adjust the gib, loosen the two locking screws (C 1) nearest the gib, then turn in the two adjusting screws (D 1) against the gib until all play is eliminated and the eccentric fits snugly in the slot in the eccentric body. Securely tighten the two locking screws (C 1).

The spring (E 1) presses against the feed eccentric cam to prevent it from moving out of position while the machine

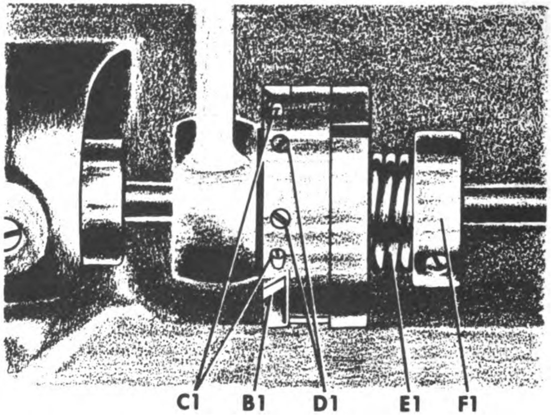


Figure 7–53.—Feed eccentric.

is operating. The collar (F 1) may be moved to the right or left to change the spring pressure. It should ordinarily be set flush with the end of the hub of the eccentric body.

To ADJUST THE STITCH LENGTH INDICATOR (fig. 7–46).—Set the machine to produce eight measured stitches to the inch. Then loosen the setscrew in the stitch indicating disk (K); press down the plunger (L) in the bed of the machine and at the same time turn the balance wheel slowly until the plunger enters the notch in the adjustable feed eccentric cam. With the machine in this position, the stitch indicating disk (K) should be set so that the figure "8" can be seen through the hole in the front of the arm; then tighten the setscrew in the stitch indicating disk.

To REENGAGE THE SAFETY CLUTCH.—The hook driving shaft and the shaft of the sewing hook are splined to prevent the hook from getting out of time. The safety clutch located in the lower belt pulley prevents damage in the event of any strain on the sewing hook by releasing the locking lever in the pulley from the notch (C 1, fig. 7–55) in the collar of the hook driving shaft.

Draw back the bed slide, turn the balance wheel back and forth slightly, and remove the material that may be jamming

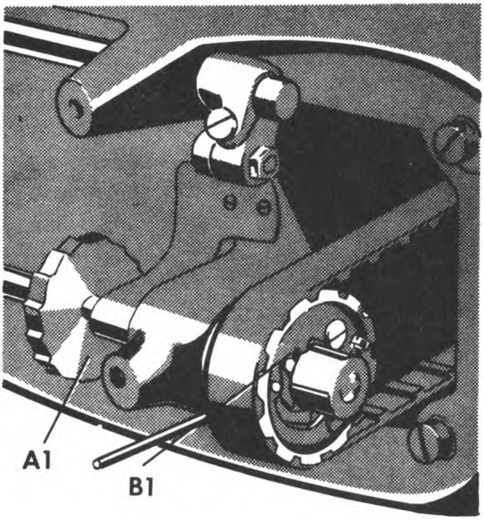


Figure 7–54.—Safety clutch disengaged.

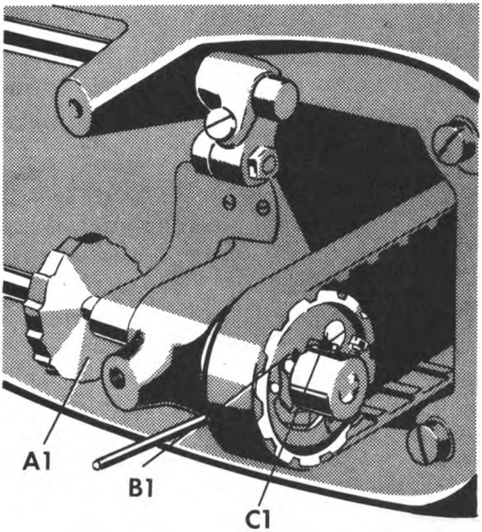


Figure 7–55.—Operating position.

the hook. If necessary to reengage the clutch, press down the lock stud (M, fig. 7–46) near the base of the arm to engage the hook driving shaft lock ratchet (A 1, fig. 7–54) which will prevent the hook driving shaft from turning backward. Turn the balance wheel away from you until the locking lever (B 1) snaps into the notch (C 1) in the shaft collar as shown in figure 7–55. Release the lock stud and resume sewing.

Transmission of Power

The transmission of power through the machine beginning with the motor is shown in figure 7–56. In order to make a lockstitch the rotary type sewing machine must perform the following:

1. The needle must pass down and up through the material to make a stitch.
2. The needle bar, carried in a frame, must move forward and backward in conjunction with the feed dog.
3. The feed dog must move upward and forward, downward and back in conjunction with the movement of the needle bar rock frame in order to feed the material.
4. The sewing hook must move in a continuous circular motion in order to pick up the needle thread and pass it around the bobbin thread thereby making a lockstitch.

All of the above movements must be in synchronization in order to make a stitch and move the material along for the next stitch.

LEGEND FOR FIGURE 7–56.

LINE OF POWER TO THE NEEDLE

1. **⅓ hp. electric motor**
2. **Round leather belt**
3. **Balance wheel**
4. **Arm shaft**
5. **Needle bar crank**
6. **Needle bar driving stud. (Located in the top cylinder of the needle bar connecting link; this cannot be seen in the illustration.)**

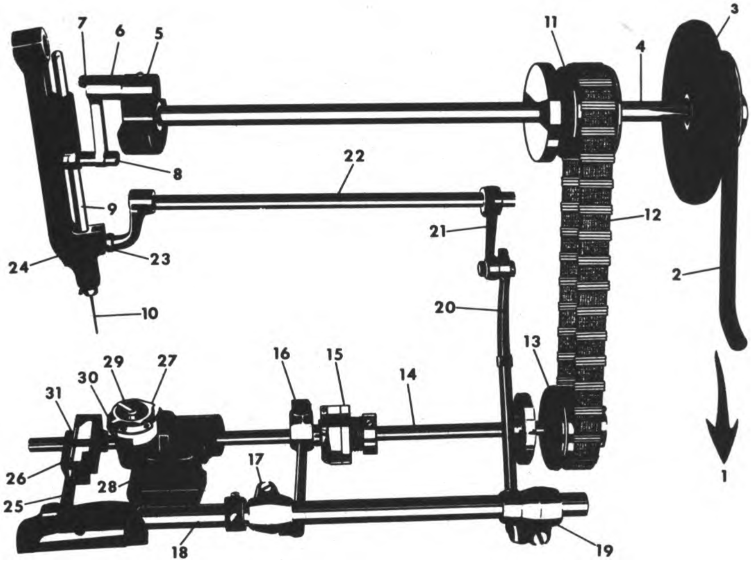


Figure 7–56.—Line of power transmission.

7. Needle bar connecting link

8. Needle bar connecting stud. (Located in lower cylinder of needle bar connecting link; this cannot be seen in the illustration.)

9. Needle bar

10. Needle

LINE OF POWER TO THE NEEDLE BAR ROCK FRAME

4. Arm shaft

11. Arm shaft pulley

12. Arm shaft connecting belt

13. Safety clutch pulley

14. Hook driving shaft

15. Feed driving eccentric

16. Feed driving eccentric connection

17. Feed driving crank

18. Feed driving rockshaft

19. Feed driving rockshaft crank

20. Needle bar rock frame rockshaft crank connection

21. Needle bar rock frame rockshaft crank

22. Needle bar rock frame rockshaft

23. Needle bar rock frame slide block

24. Needle bar rock frame

LINE OF POWER TO THE FEED DOG

4. Arm shaft
11. Arm shaft pulley
12. Arm shaft connecting belt
13. Safety clutch pulley
14. Hook driving shaft
15. Feed driving eccentric
16. Feed driving eccentric connection
17. Feed driving crank
18. Feed driving rockshaft
25. Feed bar
26. Feed dog

LINE OF POWER TO THE SEWING HOOK

4. Arm shaft
11. Arm shaft pulley
12. Arm shaft connecting belt
13. Safety clutch pulley
14. Hook driving shaft
27. Hook driving gear. (Located under bobbin assembly; cannot be seen in the illustration.)
28. Hook driving pinion
29. Sewing hook shaft. (This cannot be seen in the illustration.)
30. Sewing hook
31. Lifting cam. (This cannot be seen in the illustration.)

SEWING MACHINE COMPARISON

Sewing machines are manufactured according to rigid specifications. Yet, from machine to machine, there are small differences that occur in operation. It is well for an operator to become familiar with the machine assigned for his use. For example, one machine may require an early or late timing of the sewing hook, while another may not sew perfectly unless it is adjusted squarely on the point of reference mark. Many items such as these cannot be taught from a text but can be learned better through actual experience and working with the sewing machine. (See table 7–6.)

Table 7–6.—Comparison of sewing machine features.

Machines	Timing point	Needles—class and variety and size	Stitch regulator	Feeding action	Stitches per inch	Stitches per minute	Sewing hook axis	Bobbin rotation
111 W 150	Hook pinion gear.	135 x 7 7 to 24	Plunger in bed—indicator on uprise.	Needle and drop (compound).	5 to 32	3,500	Vertical	Counterclockwise.
111 W 155	Hook drive gear.	135 x 17 12 to 25	-----do-------	Alternating pressers, needle drop.	---do-------	2,900	---do-------	Do.
31–15	Needle bar.	16 x 87 14 to 23	Thumbscrew on uprise.	Drop feed only.	5 to 34 (Not calibrated.)	3,500	Horizontal	Clockwise.
7–31	---do---	7 x 1, 19 to 27 7 x 5, 28 to 31	-----do-------	Drop, riding presser.	2 to 8 (Not calibrated.)	550	---do-------	Counterclockwise.

NOTE: Rotary type machines splined throughout or equipped with a splined sewing hook are timed from the hook driving gear instead of the pinion gear.

TROUBLESHOOTING

The data which follows has been arranged to enable the sewing machine operator to locate and eliminate small operational troubles quickly. The remedies for the operational difficulties may be found in the information previously given in this chapter and by referring to applicable manufacturer's sewing machine manuals.

Trouble	Cause	Remedy
Upper thread breakage or skipped stitches.	Faulty thread sequence	Ascertain that wire leader is above center of each spool. Loosen upper tension disk to allow thread passage with presser foot released. Adjust controller spring to prevent excessive slack in the thread when the needle enters the material. Thread machine in accordance with manufacturer's instructions.
	Improper needle	Use correct size for thread and material.
	Needle improperly set in needle bar.	Properly set needle into needle bar.
	Needle striking or rubbing against presser foot.	Change needle if bent. Readjust presser foot.

	Improper setting of sewing hook	Set in proper relation to needle. Adjust timing of sewing hook. Adjust seating of sewing hook in the hook saddle.
	Bobbin opener improperly operating.	Adjust bobbin opener so thread will pass freely between bobbin case and throat plate.
	Improper distance of hook from needle.	Adjust hook saddle.
	Bobbin tension spring adjusting screw protruding into bobbin case.	Adjust.
	Bobbin latch bent or burred	Repair or replace.
	Needle bar rock frame loose	Adjust.
	Feed dog loose or improperly set	Adjust.
	Needle bar set too high or low	Adjust.
Machine sews satisfactorily with two plies of fabric but breaks thread with four or five plies of material.	Improper timing, excessive tension, improper size needle.	Adjust timing and thread tension. Check needle sizes. Readjust takeup lever timing.
Lower thread breakage	Old or rotten thread	Use new thread.
	Bobbin threaded incorrectly	Thread correctly.
	Bobbin thread tension too tight	Adjust tension.
	Bobbin wound unevenly	Adjust bobbin winder.
	Too much thread on bobbin	Remove excess thread and readjust bobbin winder.

TROUBLESHOOTING—Continued

Trouble	Cause	Remedy
Lower thread breakage. (Con.)	Bent bobbin	Repair or replace.
	Bobbin latch broken	Replace.
Uneven tension	Pressure on the knee lifter	Remedy sitting position at machine, or adjust the knee lifter to a more comfortable position.
	Wire leader not centered	Center above spool.
	Insufficient pressure on presser foot	Increase pressure.
	Bent bobbin	Repair or replace.
Broken needle	Forced-feeding or holding back the material.	Feed material properly.
	Loose feed dog	Readjust and tighten.
	Needle rubbing or striking the edge of the presser foot.	Adjust.
	Needle bar rock frame loose.	Adjust.
	Upper thread tension too tight.	Loosen.
	Sewing hook set too close to needle.	Adjust.
	Incorrect spacing between needle bar and presser bar.	Adjust.
Improper feed. (Not sufficient pressure on presser foot.)	Feeding motion irregular	Correct.
	Side play or slack in feed driving rockshaft.	Adjust.
	Feed dog striking throat plate.	Adjust feed dog.

Jammed machine	Thread jammed under bobbin case	Remove jammed thread.
	Needle bar set too high	Adjust.
	Loose and protruding pinion gear screws.	Adjust.
	Feed dog set too high	Adjust.
	Incorrect spacing between needle and presser bar.	Adjust for correct spacing.
	Improper setting of hook saddle	Adjust.
	Foreign matter under the bobbin case opener lever.	Clean.
	(Safety clutch will not reengage if obstruction is not removed.)	
	Bobbin case opener lever improperly set.	Adjust.
Noisy machine	Lack of oil	Oil according to manufacturer's instructions.
	Tension too tight	Adjust.
	Takeup lever out of time	Adjust timing.
	Controller spring too tight	Adjust.
	Bobbin opener improperly adjusted.	Adjust.
	Improper setting of feed dog	Adjust.
	Loose working parts	Adjust and tighten.

You cannot order sewing machine parts and expect delivery within a week. The only small parts listed in the ASO catalog are needles. The General Stores Catalog lists more parts, but they do not cover all the different types of sewing machines used in the Navy.

It is the responsibility of the Parachute Rigger in charge to make it his business to anticipate the loss and damage of certain small items. All sewing machine parts with the exception of the needles listed in the catalog must be ordered through the Supply Office using an "Open Purchase" contract with the respective sewing machine manufacturers. This procedure takes time and is costly, but it is the only method to follow for the replacement or stocking of spare parts.

In order to accurately place an order for sewing machine parts, it is necessary to list the manufacturer, the manufacturer's part number for each item, the nomenclature, and quantity required. It is also a good practice to mention the type or style sewing machine for which the parts are intended. This information will help the Supply Officer and will expedite the order.

Carefully follow the manufacturer's instructions for ordering parts. These instructions are usually found in the beginning of manufacturer's parts catalog. Every unit utilizing a sewing machine must have a parts catalog for each type machine. Do not wait until something goes wrong before looking for a parts list.

Needles are listed separately in some manufacturer's operations manuals. Whatever sewing machine is in the shop make certain there is a complete source of information on hand to keep it in commission.

Under the present supply system an open purchase order for sewing machine parts may take as long as six months to be filled. Realizing this, it is wise to stock a small supply of the parts that most frequently require replacement through loss or normal wear.

A justifiable stock list follows:

1. Needles, various popular sizes.
2. All types of screws most frequently used in minor adjustments.
    a. Needle setscrews.
    b. Needle bar connecting stud pinch and/or setscrews.
    c. Bobbin case tension spring regulating screws.
    d. Hook saddle screws (rotary type machines).
    e. Hook driving and pinion gear screws (rotary type machines).
    f. Feed cam setscrews (oscillating type machines).
    g. Throat plate screws.
3. Springs.
    a. Bobbin case tension springs.
    b. Thread controller springs.
4. Bobbin cases for oscillating type machine.
5. Bobbins.
6. Presser feet.
    a. Zipper feet, right and left.
    b. See parts catalog or write to manufacturer for information on presser feet for various sewing jobs.
7. Round or V-type leather belting and wire clamps for securing ends of belts.

Store spare parts in a sectioned kit where the quantity of each item may be easily accounted for. Initiate a new order when the supply nears depletion.

No special tools are necessary for installing the above parts or for making minor adjustments to the sewing machines discussed in this chapter.

QUIZ

1. On a 31–15 sewing machine the feed eccentric is located on the
   a. arm shaft
   b. hook drive shaft
   c. feed driving rockshaft
   d. shuttle drive shaft

2. The feeding action of the 31–15 sewing machine is
   a. compound
   b. needle and drop
   c. drop and riding presser
   d. drop only

3. The pressure on the presser foot on a 31–15 sewing machine is regulated by a
   a. thumbscrew on top of arm
   b. thumbscrew cap on top of presser bar
   c. locknut on lever on uprise
   d. thumbscrew in back of arm

4. On the 31–15 sewing machine there are
   a. no tension units
   b. 4 tension units
   c. 2 tension units
   d. 3 tension units

5. The class and variety of needle to be used in the class 31–15 is
   a. 7 x 3
   b. 14 x 23
   c. 16 x 87
   d. 7 x 1 or 7 x 5

6. The proper size sewing machine needle to be used should be determined by the
   a. machine being used
   b. thread size and material being use
   c. speed of machine
   d. size of hole in feed dog

7. The part of the needle that should always face way from the sewing hook is called the
   a. scarf
   b. long thread groove
   c. shank
   d. short thread groove

8. When first starting to sew with any lockstitch sewing machine the operator should
   a. hold both threads for the first two stitches
   b. not hold thread
   c. hold bobbin thread
   d. hold upper thread

9. Besides raising the presser foot, the knee lifter will
   a. engage the clutch of the motor
   b. release upper tension
   c. raise the pitman rod
   d. raise the needle bar

10. Needles for sewing machines should be ordered by
   a. the box
   b. quantity, size, class and variety
   c. number
   d. class and variety

11. The greatest damage from excess oil, when using a sewing machine, will be
   a. poor operation
   b. stained work
   c. thread breakage
   d. excessive wear of parts

12. A perfect lockstitch will lock in the center of the
   a. top ply of material
   b. bottom ply of material
   c. plies of material
   d. none of the above

13. On the 111 W 150, the needle bar moves up and down in the
   a. uprise
   b. takeup lever
   c. needle bar rock frame
   d. needle bar rock frame rockshaft

14. The adjustment point for raising or lowering the feed dog on a 111 W 150 is the
   a. feed lifting cam
   b. feed driving eccentric
   c. nut in feed lifting cam fork
   d. screw on after side of feed bar

15. The cam fork on the 111 W 150 is attached to the
   a. hook drive shaft
   b. feed drive shaft
   c. feed bar
   d. saddle

16. The 111 W 150 has
    a. 4 gears
    b. 6 gears
    c. 2 gears
    d. 1 gear

17. When setting the needle bar on a 111 W 150, the lower timing mark will
    a. be disregarded
    b. be used
    c. not be visible
    d. be ⅛ inch below upper timing mark

18. The distance between the two timing marks on the needle bar of a 111 W 150 is
    a. 17/32 inch
    b. 9/32 inch
    c. 3/32 inch
    d. ⅛ inch

19. The number of stitches per inch are changed on the 111 W 155 sewing machine by use of the
    a. plunger in the bed
    b. spindle in arm shaft
    c. thumbscrew on uprise
    d. large screw in the feed driving eccentric

20. Pressure on the material is regulated on a 111 W 155 machine by the
    a. thumbscrew on top of face
    b. hexagon shaped screw over presser bar spring
    c. thumbscrew on top of arm
    d. lifting releasing lever bracket

21. When setting the sewing hook (111 W 150–155) to and from the needle, the hook point should
    a. be even with eye of needle
    b. be as close to the needle as possible without actually striking it
    c. pass within 1/16 of an inch from the needle
    d. actually strike the needle

22. The purpose of the hook guard washer (111 W 150–155) is to
    a. protect the bobbin case
    b. prevent the needle from striking the sewing hook
    c. protect the bobbin case opener
    d. prevent the sewing hook from striking the throat plate

23. The 7–31 sewing machine employs a needle which does not have a
    a. long thread groove
    b. short thread groove
    c. scarf
    d. shank

24. The 7–31 sewing machine employs
    a. drop feed
    b. needle feed
    c. compound feed
    d. puller feed

25. One part not found on a 31–15 sewing machine that is a part of the 7–31 machine is a
    a. takeup lever
    b. tension wheel
    c. feed dog
    d. presser bar

CHAPTER 8

FASTENERS

FASTENERS USED IN PARACHUTE WORK

Fasteners are designed for every need and purpose in the textile industry. Fasteners of various sizes, shapes, and descriptions are serviced by the Parachute Rigger. Some are small, some are large, some are complicated. All serve the same purpose; they hold things together, either permanently or temporarily.

Certain fasteners are designed to hold with tenacity, while another fastener similar in appearance will release its grip easily. Others will release only if pulled or pried in a certain direction. Permanent type fasteners act as anchoring and reinforcing points for pockets and corners, and innumerable other purposes.

The Parachute Rigger must be able to set, repair, and renew the following fasteners, or take the proper corrective action:

Snap fasteners
Grommets
Speedy rivets
Slide fasteners

Snap Fasteners

Snap fasteners used mostly in parachute manufacture and general utility work are described in the following paragraphs. Other fasteners are listed in the ASO Catalog, Class 42.

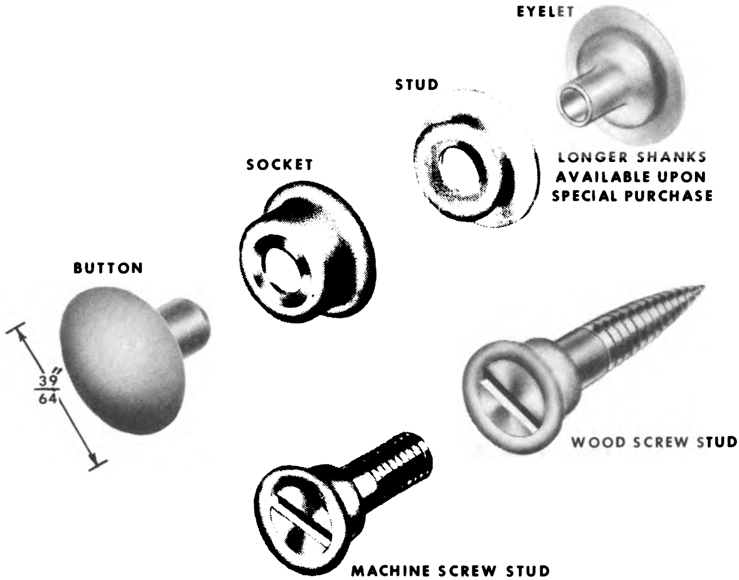


Figure 8–1.—Regular wire spring clamp type.

Regular wire spring clamp type, NAF 312320.—Figure 8–1 shows the parts of the wire spring clamp, popularly called Durable Dot.

Figure 8–2 illustrates the small wire spring clamp type, NAF 312321. These fasteners and others are shown in the Air Force-Navy Aeronautical Standard Drawing Sheet: AN 227, Sheets 1 through 3. These sheets carry complete information on dimensions, materials, and plating specifications.

The regular and the small wire spring clamp type fasteners are designed with a strong grip, and they will release or separate when pulled in any direction. The regular size wire spring clamp is the one most frequently used. It is used in the manufacture of back pads and parachute packs. It is also used on flight clothing where the additional security offered by the "three-way snap" is not needed. NAF blueprints refer to the parts of this fastener as, –6, –7, –8, and –9,

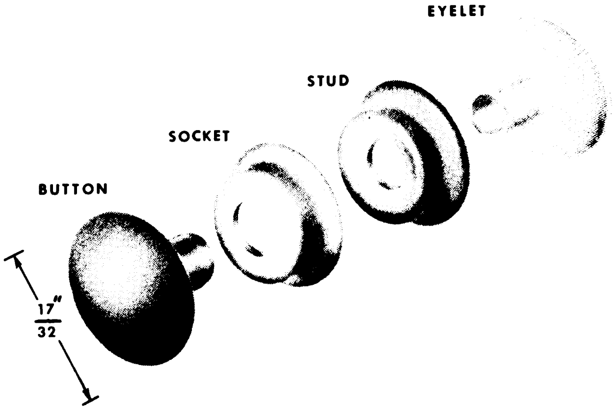


Figure 8–2.—Small wire spring clamp type fastener.

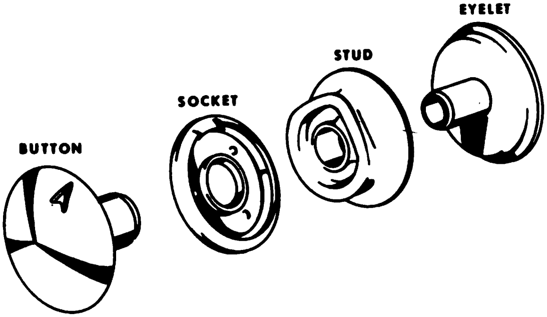


Figure 8–3.—Three-way locking snap type fastener.

which means, button, socket, stud, and eyelet. All parts are plated. The finish of a –6B is black. Notice the difference in studs in figure 8–1 which make it possible to mount the fastener in wood or metal.

Three-way locking snap type, NAF 312326.—Figure 8–3 illustrates the parts of this fastener which are manufactured in one size.

It is used on flight clothing, parachute packs, and back pads. Since this fastener will open only when pulled in a certain direction, it is not used in conjunction with any quick opening keepers or other devices connected with the

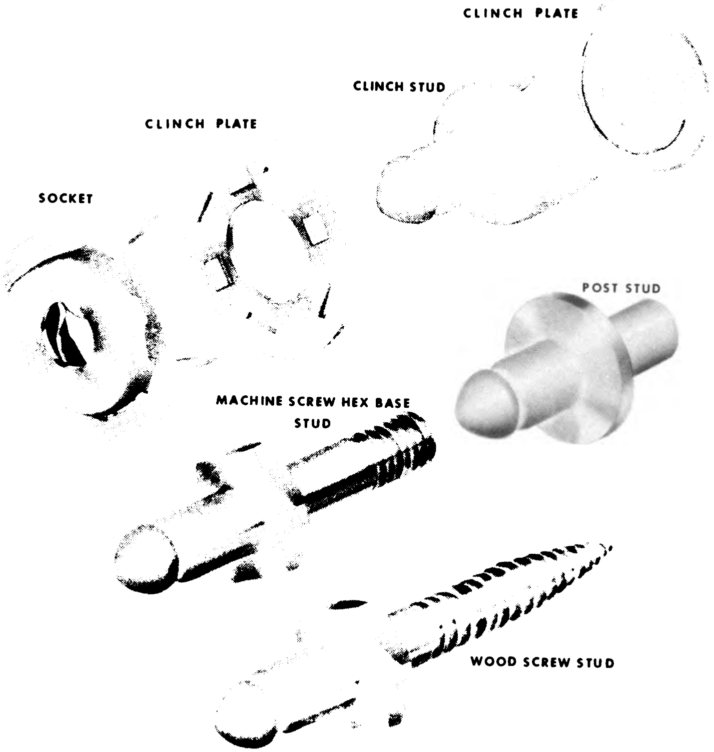


Figure 8–4.—Large curtain type snap.

functioning of a parachute. For example, the lift web keepers of a seat type parachute are equipped with the REGULAR WIRE SPRING CLAMP FASTENER designed for quick release. However, the two vertical keepers which hold the shoulder straps and the back strap are fitted with THREE-WAY LOCKING SNAPS. (Do not confuse the two different fasteners.)

LARGE CURTAIN TYPE, NAF 49955.—The parts of this fastener (LIFT-THE-DOT), which is made in two sizes and many types of studs for wood and metal mounting, are shown in figure 8–4. This fastener has various uses, especially for truck and boat covers.

SMALL CURTAIN TYPE.—This fastener is shown in figure

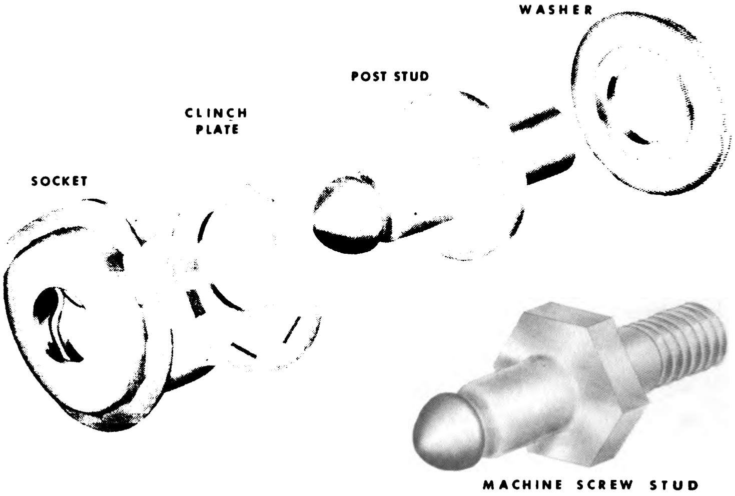


Figure 8–5.—Small curtain type snap.

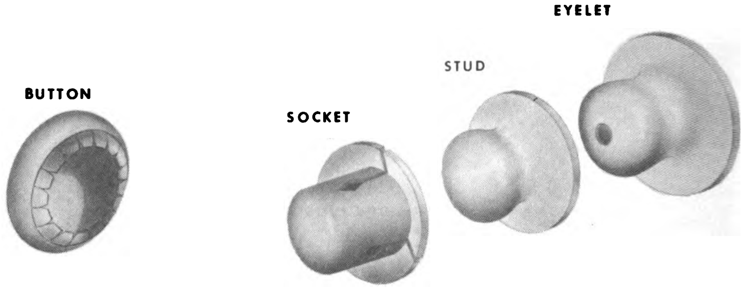


Figure 8–6.—Glove snap type fastener.

8–5. It is the same as the larger one, but is used for lighter weight work.

Glove snap type, NAF 312322.—Figure 8–6 illustrates this fastener. It is used for flight clothing.

Setting Tools

The setting tools necessary to install snap fasteners are available to the larger maintenance units such as CVA's, AV's, FASRons, and NAS Parachute Lofts. A check on the

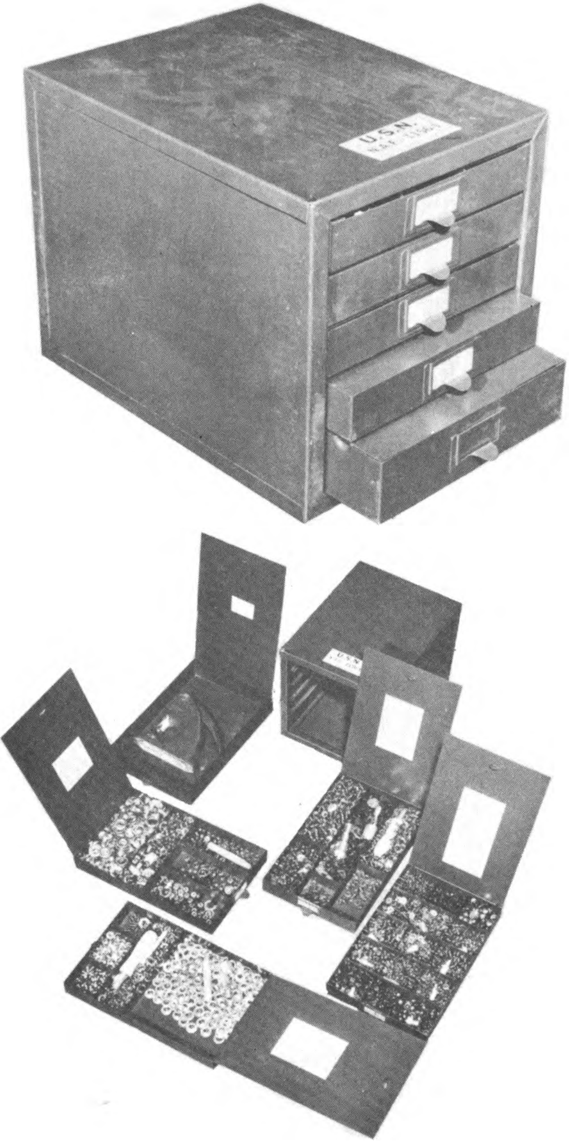


Figure 8–7.—Fastener kit and setting tools.

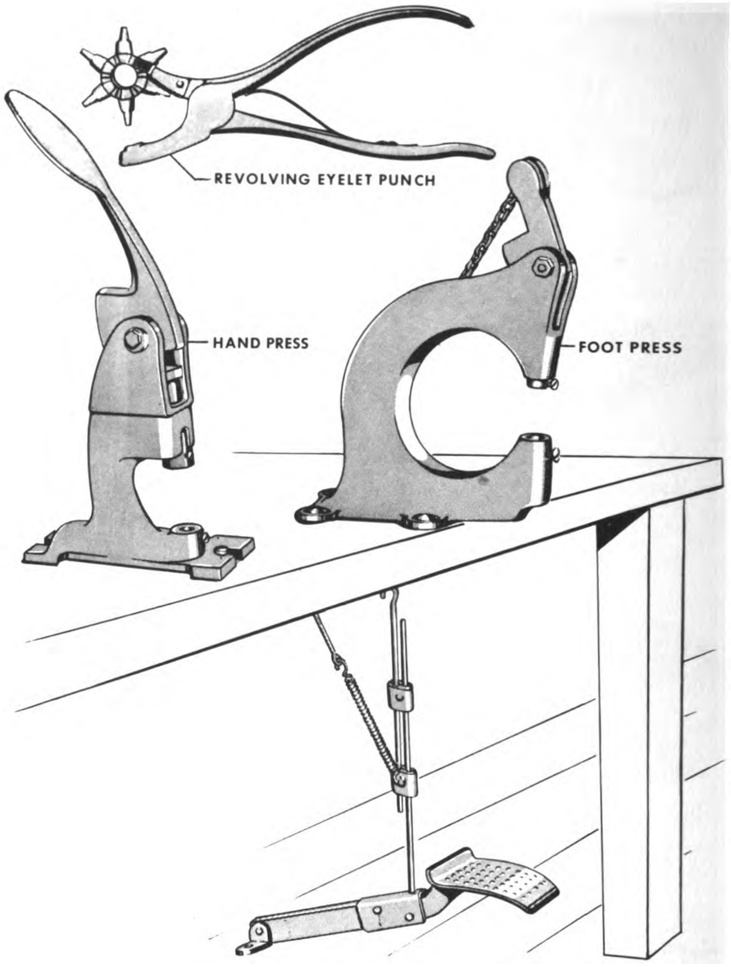


Figure 8–8.—Hand and foot presses.

Section "G" Allowance Lists will reveal the unit's eligibility for any particular item. Allowance lists are subject to change and it is everyone's responsibility to make every effort to see that they are kept up to date.

Class 41, ASO, lists a fastener kit which consists of a small cabinet, five drawers, and a supply of snap and other type fasteners. The chucks and dies with a hand press are also supplied. The fasteners are replenishable out of Class 42 ASO stock, but the chucks and dies are not replenishable. When a chuck is lost or damaged, it takes an "Open Purchase Order" to replace it because provisions have not been made for this contingency.

Figure 8–7 illustrates the fastener kit and setting tools available for the snap type fasteners.

Parachute overhaul stations and manufacturers use more elaborate presses to expedite their production. The expense for such machinery is justifiable since this speeds up production and provides more time for other gainful activities. A squadron or general maintenance shop can not justifiably request an automatic eyelet machine or special sewing machine for sewing eyes on packs, as their need for such machinery is not great enough.

Figure 8–8 illustrates the hand and foot presses set up for action. Notice the revolving eyelet punch used to make small holes of varying sizes in preparation for setting the fasteners.

Installation of Snap Fasteners

Figures 8–9 through 8–11 illustrate the methods and tools employed in setting three types of snap fasteners.

Grommets

The grommet serves as a reinforcement around a hole or cut. It can be round, square, or oblong; and it can be made from metal, rubber, or fabric. The type used for parachutes is round and made of metal.

The grommet used in parachute pack side flaps is a plain unit of special size and contour and requires special dies to set it. Today these grommets are set under a process which fuses the edge of the hole in the material and prevents the circular cut from fraying. (See fig. 8–12.)

Figure 8–13 illustrates the sizes and shapes of plain and

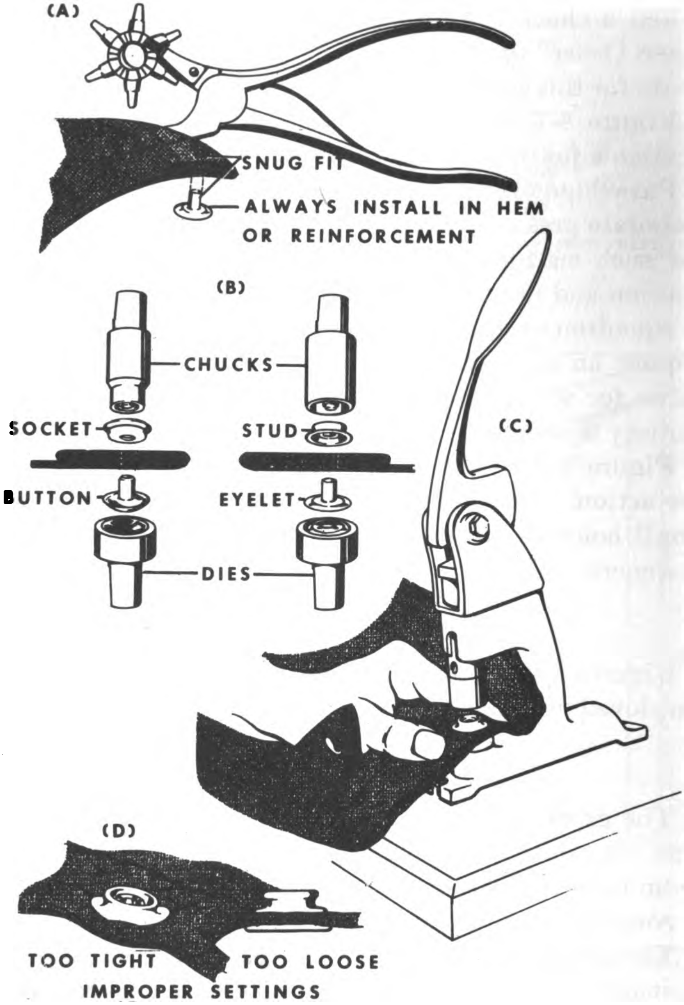


Figure 8–9.—Steps in installing the regular wire spring clamp type fastener.

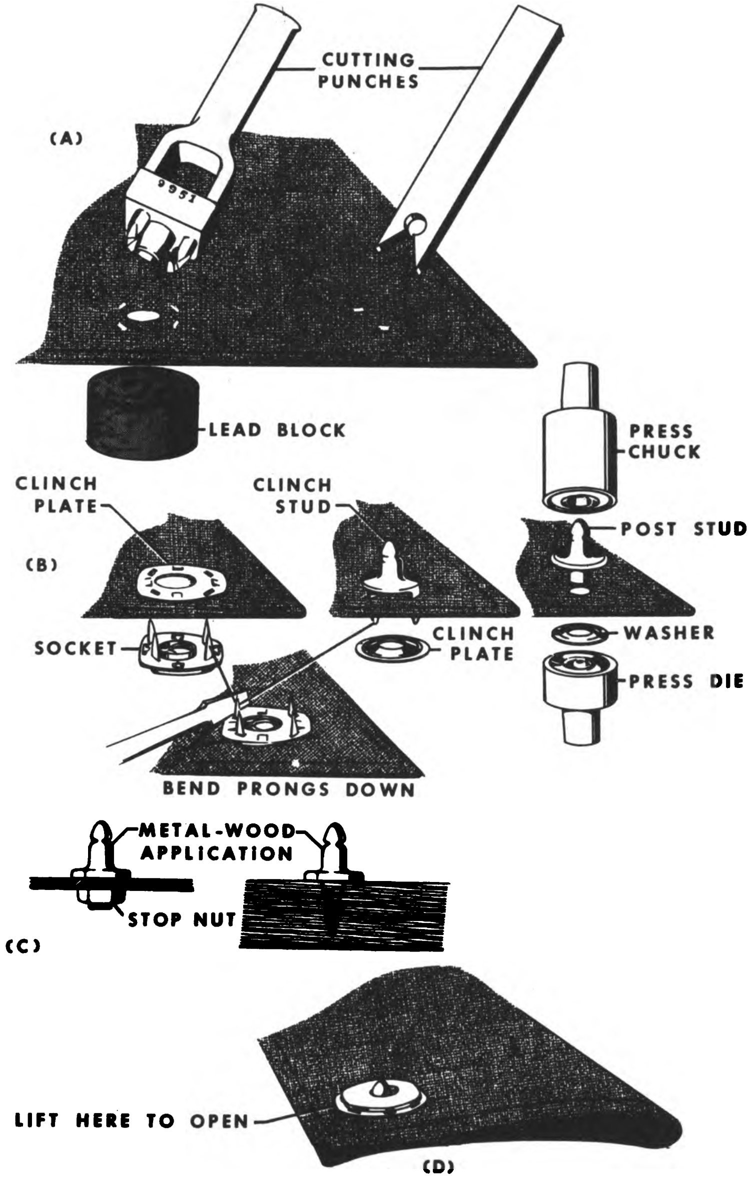


Figure 8–10.—Steps in installing the large curtain type fastener.

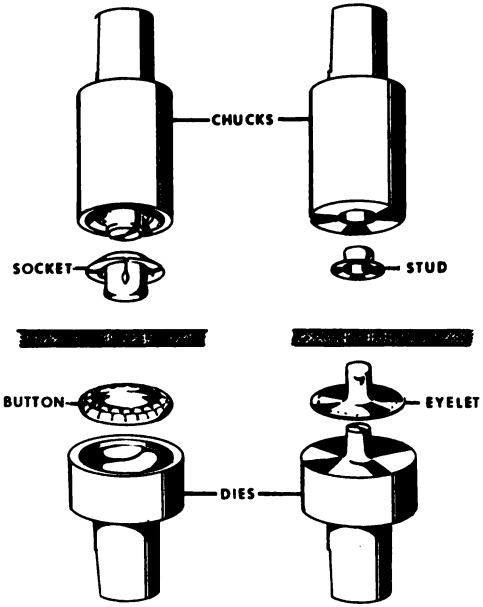


Figure 8–11.—Steps in installing the glove snap type fastener.

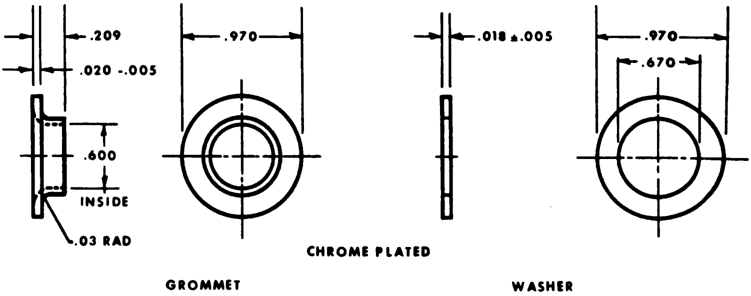


Figure 8–12.—Grommet and washer for parachute pack.

spur grommets. Design specifications may be found in Army-Navy Aeronautical Standard Drawing AN 230.

Whenever possible reinforce the material with a hem or patch before installing a grommet. The spur grommet is designed for heavy work and stress and should not be used

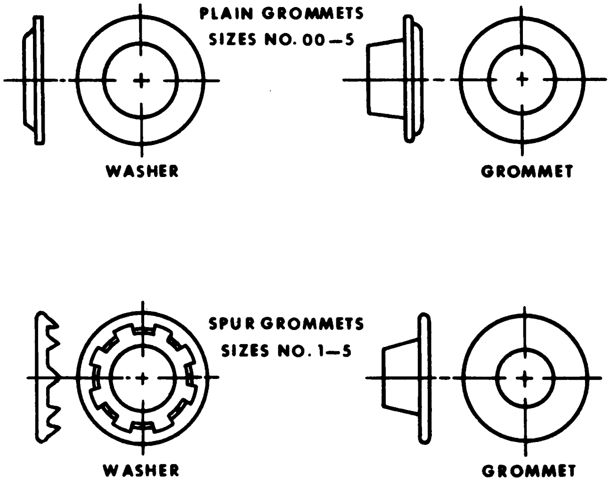


Figure 8–13.—Grommets, plain and spur.

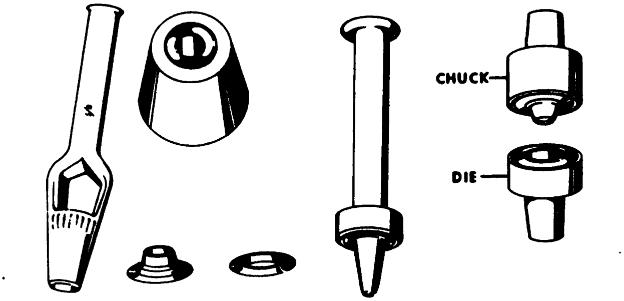


Figure 8–14.—Grommet setting tools.

on lightweight fabrics. Figure 8–14 shows the hand and foot press dies and chucks used to set a plain or spur grommet.

Figure 8–15 illustrates the steps used in installing a plain or spur grommet.

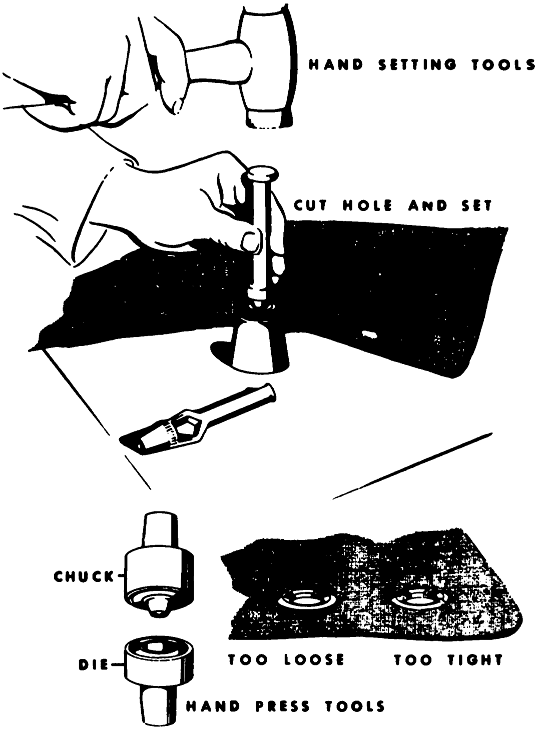


Figure 8–15.—Steps in installing a grommet.

Speedy Rivets

Speedy rivets may supplement stitching as an additional reinforcement. One very popular use is in the open corners or pockets of certain clothing. They can also be used to secure a loop in a leather belt or to join two pieces of fabric, and in countless other ways. Figure 8–16 illustrates two speedy rivet sizes and the method of setting them.

Removing Faulty Fasteners

A damaged snap fastener is removed by cutting the shank or post securing the socket of one half and the stud of the other half. A sharp pair of diagonal cutting pliers or end cutters will do the job easily, but considerable care must be

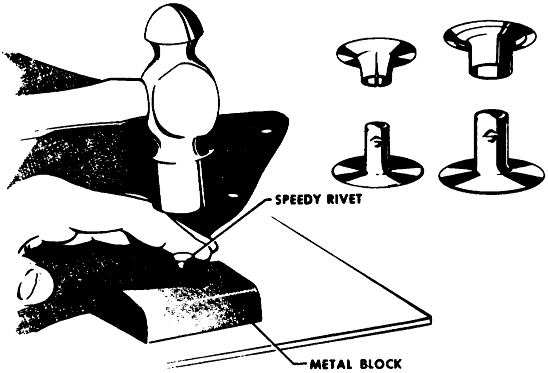


Figure 8–16.—The speedy rivet and steps in setting it.

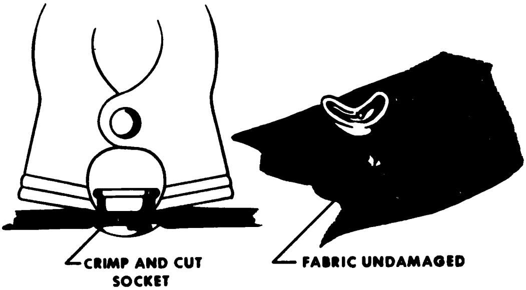


Figure 8–17.—Removing damaged snap fasteners.

taken not to cut the fabric between the crimped shanks or extensions. Figure 8–17 illustrates this method of removal.

Some Parachute Riggers prefer to drill the fasteners out, and in some cases this is the better method. When the material is brittle and easily damaged, a drill will do the job more safely. However, one must take care to secure the fastener so it will not turn and tear the hole.

Grommets can be removed by prying the shank away from the washer until the shank is uncrimped enough to permit the washer to be withdrawn.

Use a pair of diagonal cutting pliers to remove a speedy rivet. Cut the crimped shank half way between the two parts while taking care not to damage the fabric.

Slide Fastener Kit

In addition to common tools such as screwdrivers, pliers, awls, knives, scissors, and needles, a well-equipped slide fastener kit should be included in loft equipment.

Four slide fastener-kit tools illustrated in figure 8–18 are the pull-up pliers, nippers, stop-closing pliers, and bent-tip awl.

End cutters or nippers are used for removing or cutting off stops and teeth. Stop-closing pliers are designed to span over the slider and clamp the stops in position. An awl with a bent tip is a handy implement for closing the teeth by hand.

Slide Fasteners

The types of slide fasteners used in flight clothing and other items of aviation equipment are shown in figure 8–19.

A slide fastener is comparatively simple in construction, but sometimes proves troublesome. The various parts of slide fasteners are identified in figures 8–20 and 8–21 so that no difficulty will be experienced in their operation and installation.

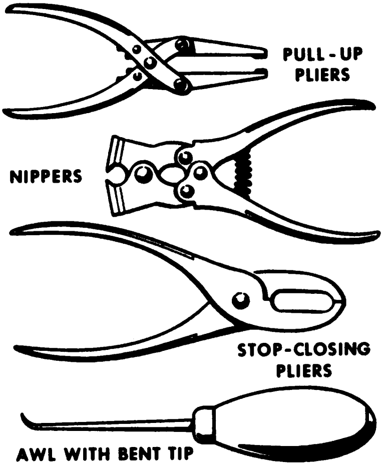
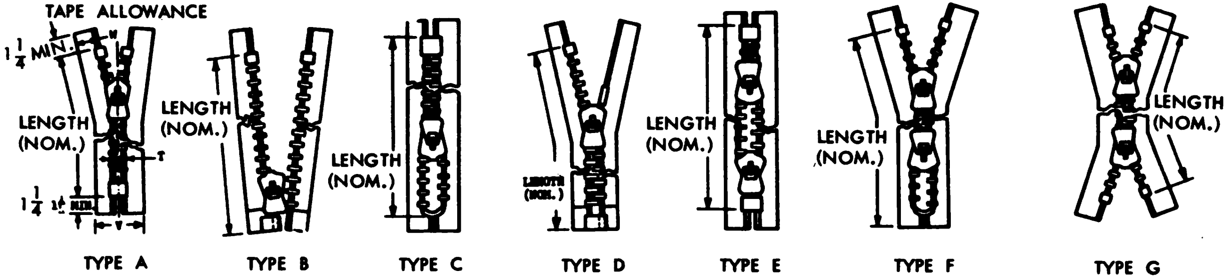


Figure 8–18.—Four indispensable slide fastener-kit tools.



TYPE A - NON-SEPARATING, SINGLE ACTION.
TYPE B - SEPARATING, SINGLE ACTION.
TYPE C - NON-SEPARATING, SINGLE ACTION WITH BRIDGE STOP.
TYPE D - SEPARATING, SINGLE ACTION, QUICK DETACHING.
TYPE E - NON-SEPARATING, DOUBLE ACTION, CENTER OPENING.
TYPE F - NON-SEPARATING, DOUBLE ACTION WITH BRIDGE STOP.
TYPE G - SEPARATING, DOUBLE ACTION, END OPENING.

SIZE 0 - LIGHT SERVICE.
SIZE 1 - LIGHT-MEDIUM SERVICE.
SIZE 2 - MEDIUM SERVICE.
SIZE 3 - MEDIUM HEAVY SERVICE.
SIZE 4 - HEAVY SERVICE.

STYLE S - STANDARD NON-LOCKING.
STYLE L - LOCKING.

Figure 8—19.—Fasteners—interlocking slide.

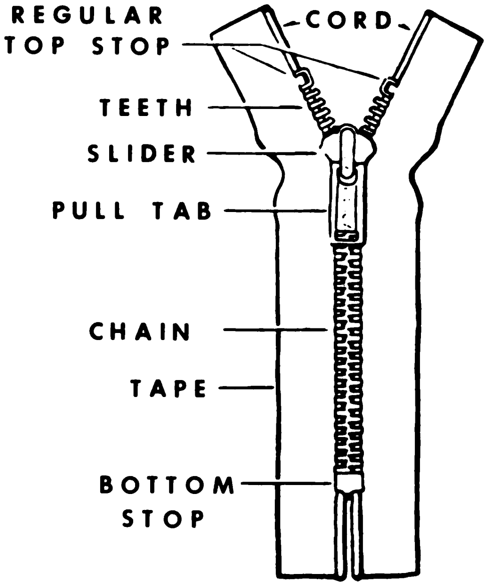


Figure 8–20.—Regular-type slide fastener.

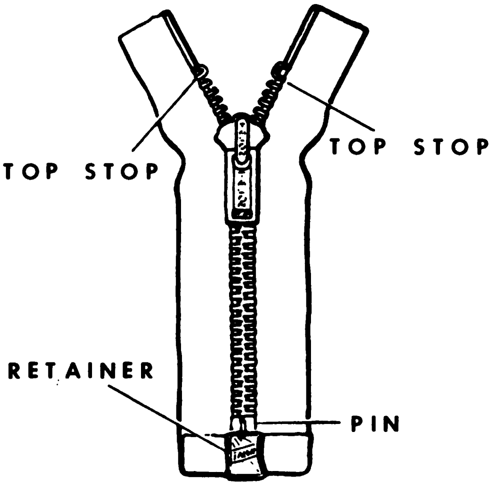


Figure 8–21.—Separating-type slide fastener.

A slide fastener consists of two rows of teeth (hollow cones or scoops) facing each other. When brought together at the proper angle, each tooth is designed to fit within the tooth opposite.

When closed, the slide fastener teeth cannot be parted except through use of the SLIDER, which when moved displaces the teeth at the proper angle for meshing and unmeshing.

The small clips at the top and bottom of slide fasteners are designed to keep the slider from running off the track. Certain types of fasteners are equipped with a small retainer and pin arrangement on the bottom to permit the fastener to separate.

PRECAUTIONS.—Ordinary slide fasteners are designed for flat, smooth operation, and both hands are required for proper functioning. The chain should be stretched taut with one hand and the slider worked (without force) with the other.

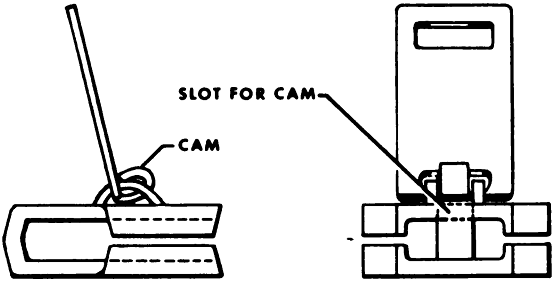
If a garment is composed of soft nappy material or lined with wool or fur, the slide fastener should be operated with great care to prevent jamming the slider.

Grease or oil often lodge between the tiny hollow parts of the teeth and accumulate dirt and lint. This causes stiff operation of the slider.

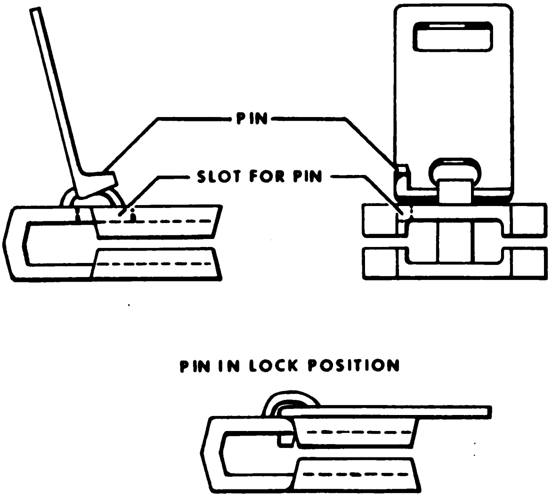
A casual inspection will determine whether a slider is the locking type. Always be certain that the pull tab is lifted at right angles to the slider before attempting to move the latter. Figure 8–22 shows the relative positions of the pull tab.

TROUBLESHOOTING.—A torn or ripped cord cannot be patched, but should be replaced with a complete new slide fastener. If the cord is damaged near the top or bottom of the fastener, and the injured ends can be cut off to shorten the slide fastener without hampering the usefulness of the garment, an effective repair can be made.

Loose or missing teeth and stops will cause trouble. If teeth or stops are not tightened, they will eventually be lost and tear the cord. In repairing such damage, see that the loose stop nearly touches the teeth, then squeeze tightly with pliers. Set the loose teeth parallel with those adjacent, and



SLIDER WITH CAM TYPE LOCK



SLIDER WITH PIN TYPE LOCK

Figure 8–22.—Locking sliders.

apply pressure with pliers. If a replacement stop is not available, it can be replaced with soft wire. Heavy thread may be substituted for the wire.

A missing tooth can be replaced by carefully removing two opposite teeth from the bottom or top of the chain. Use one of the teeth as a replacement. Move the stop or stops so they nearly touch the teeth, then tighten. This will keep both sides of the chain the same length.

Difficulty in moving the slider may be caused by the jaws of the slider being too tight. Insert a screwdriver between the jaws and very gently pry them apart until free operation is effected. If teeth are gummed with oil or grease, wipe or scrub the chain with a piece of rough material, an old toothbrush, or even a pipe-cleaner saturated with a cleaning fluid. To lubricate the chain, apply one drop of oil or a pinch of graphite between thumb and forefinger and run the chain up and down between the fingers.

Should the slider become jammed with fur, wool, or other material, carefully remove such matter with a pin or needle while gently pulling the slider until it is released. If it is so badly jammed that it resists all efforts, remove the slider by carefully bending the jaws apart and returning the jaws to their original position; then replace the slider on the chain, as will be described later.

The majority of pull tabs have two small projections fitting into slots on each side of the slider. To remove the pull tab, use two pairs of pliers, one on each side, and twist in opposite directions. In replacing pull tabs, this procedure is reversed. Pull tabs furnished as replacements need only to be squeezed onto the slider.

A smashed slider may be removed by inserting two small screwdrivers, one on each side of the chain, to force the jaws apart.

MAJOR REPAIRS.—Most slide fastener trouble may be traced to a bent slider in which the jaws are either spread too far apart or too close together, instead of being parallel. The proper procedure for removing and replacing a slider on the chain following repair is explained in the following paragraphs. (Since the procedure for the replacement of sliders on the regular-type and separating-type slide fasteners are considerably different, they will be treated separately.)

To remove the slider from the **REGULAR-TYPE SLIDE FASTENER**, carefully rip the stitches from the **BOTTOM** of the slide fastener to expose the ends of the tape. Then remove the bottom stop and slip the slider off the bottom of the chain and entirely off the cords and tape, as shown in figure 8–23. If repair is impossible due to a severed cord, discard the slide fastener in favor of a new one.

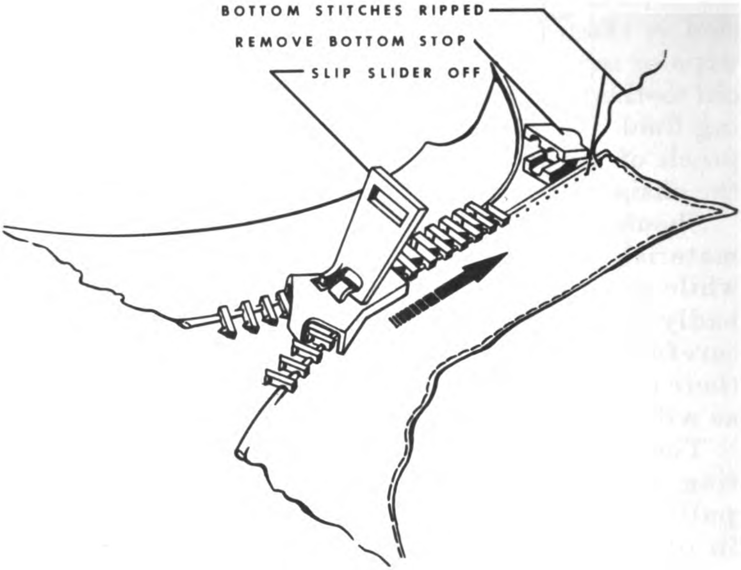


Figure 8–23.—Remove the slider from the cords and tape.

To replace the slider on a regular-type slide fastener, thread the two bottom cords into the wide end of the slider. Hold the tape so that the bottom teeth are correctly matched as shown in figure 8–24. Then draw the slider upward until the teeth mesh for several inches. Without allowing the teeth to separate, clamp the bottom stop close to the teeth and over both cords as shown in figure 8–25. Replace the tape ends and ripped stitches by hand or machine.

To remove a damaged slider on a SEPARATING-TYPE SLIDE FASTENER, carefully rip the stitches at the TOP of the slide fastener, on the retainer side only, thus exposing the end of the tape. Remove the top stop, slip the slider off the top of the chain, and completely remove it from the cord and tape. Repair or replace the slider.

To replace the slider on a separating-type slide fastener, thread the retainer side cord into the narrow end of the slider, and allow the slider to slip down the chain. Replace

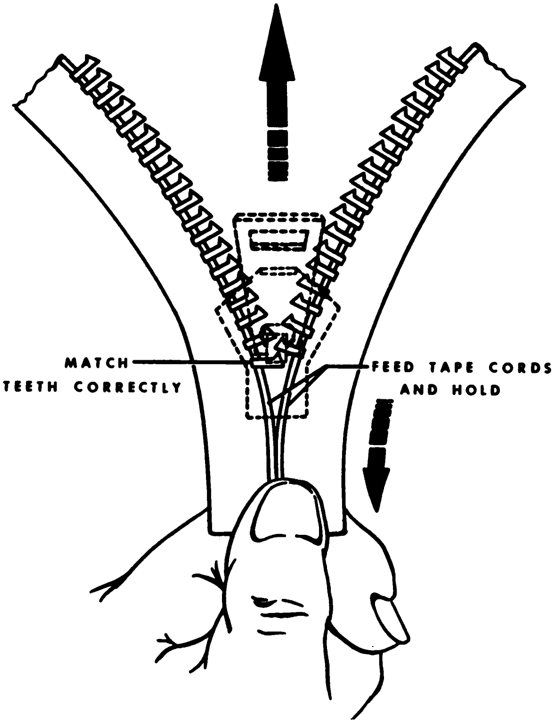


Figure 8–24.—Hold the tape and match the teeth correctly for equal length of each section.

the tape end and ripped stitches by hand or machine. (See fig. 8–26.)

To replace the slider on the top of a regular-type slider fastener with the aid of pull-up pliers, slip the tool over the bottom stop, clamp together, and pull upward exactly like a slider as shown in figure 8–27. Close the entire chain in this manner. Thread the two top cords into the narrow end of the slider, holding the teeth meshed until they enter the slider. Replace the top stops, tape ends, and ripped stitches by hand or machine.

SHORTENING A SLIDE FASTENER.—To shorten a slide fastener, first determine the length required. The chain should be about ½ inch shorter than the opening in the material or

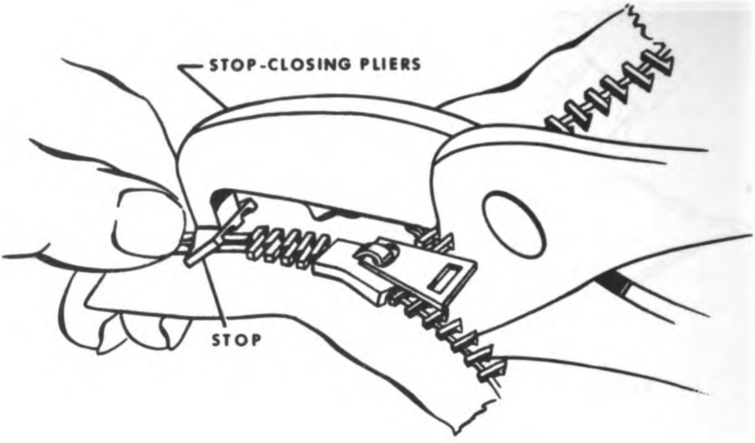


Figure 8–25.—Crimp the bottom stop close to the teeth and over both cords.

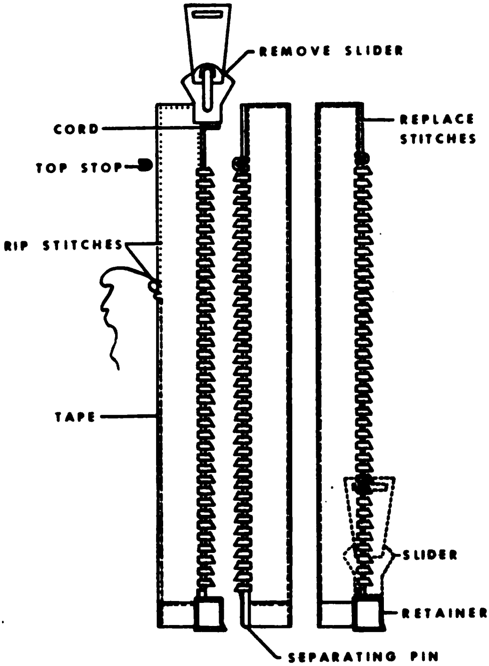


Figure 8–26.—Changing a slider on separating-type slide fastener.

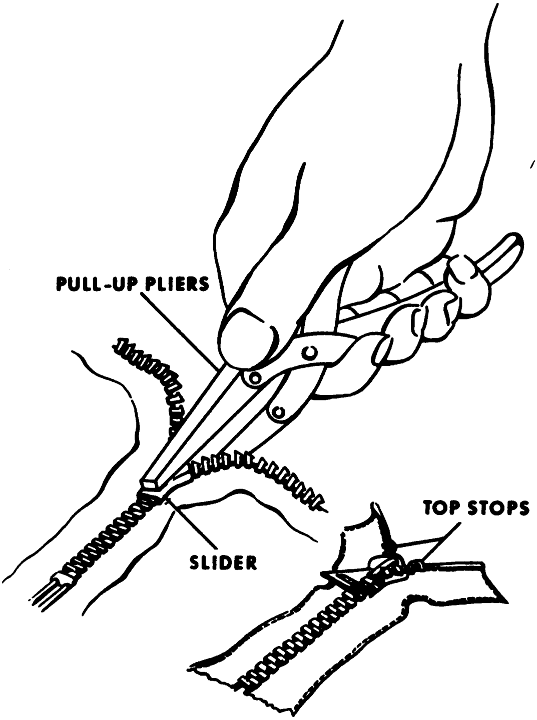


Figure 8–27.—Closing slide fastener with pull-up pliers.

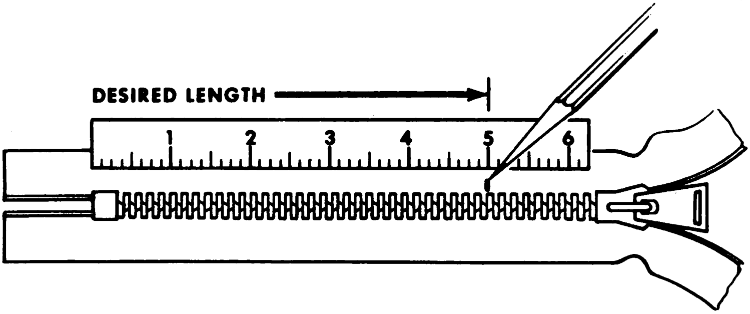


Figure 8–28.—Mark from bottom stop upward.

garment. Mark the desired length, measuring from the bottom stop upward. (See fig. 8–28.)

Open the chain to any point below this pencil mark, as shown in figure 8–29.

Cut directly across the tape about 1 inch above the mark,

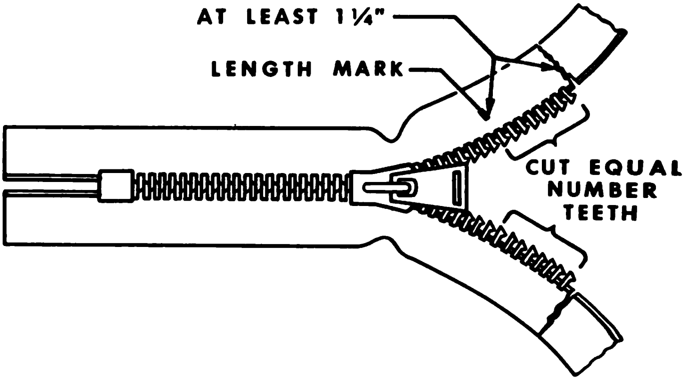


Figure 8–29.—Open chain below pencil mark.

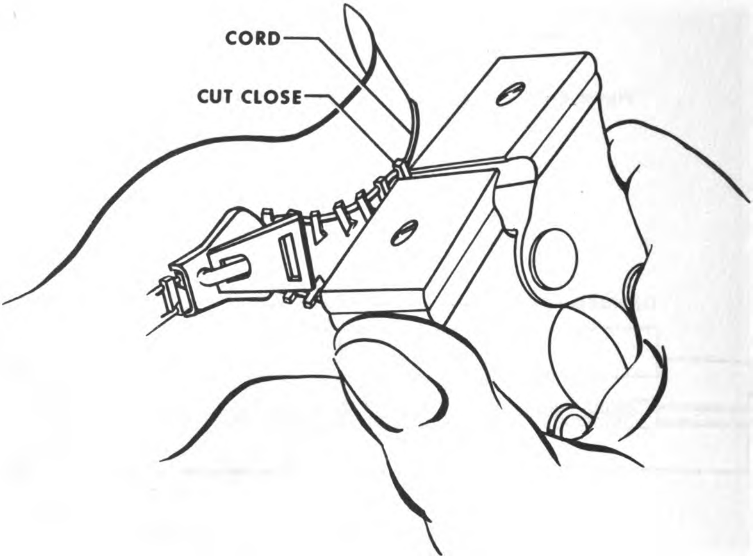


Figure 8–30.—Cut close to the cord.

as figure 8–29 indicates. Then cut off the teeth from the mark to the end of the tape. Cut an equal number of teeth from each side of the chain. Figure 8–30 illustrates this step.

When the two stops are attached, the zipper is completely shortened.

SEWING.—The slide fastener presser foot will serve not only as a guide for a neat row of stitches, but will also prevent

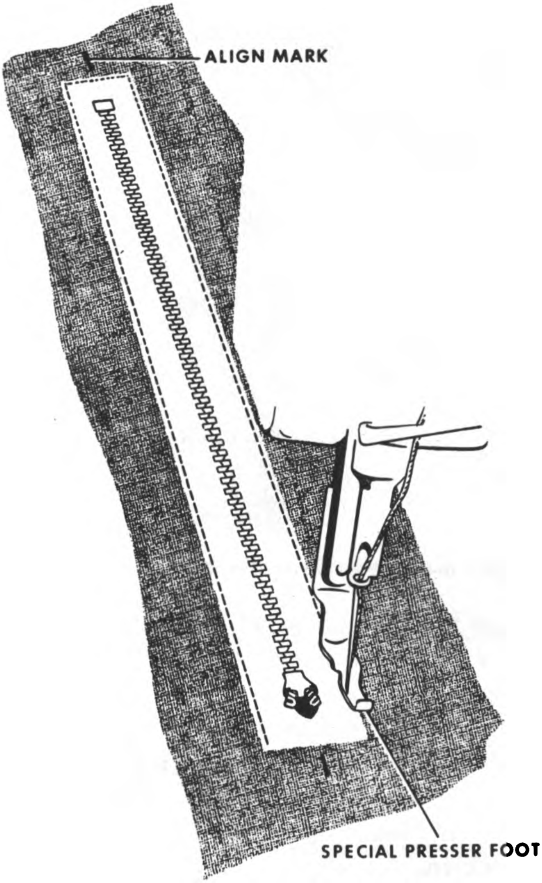


Figure 8–31.—Installation of a slide fastener. Step 1.

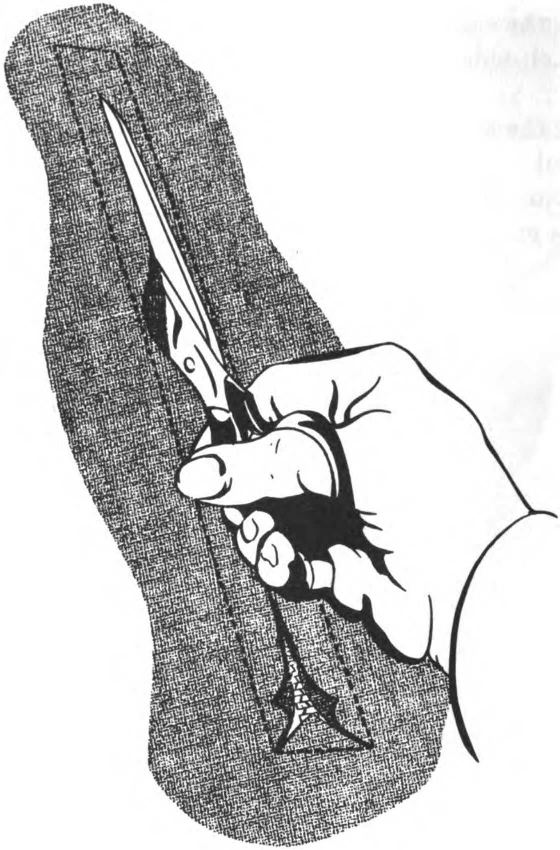


Figure 8–32.—Installation of a slide fastener. Step 2.

the foot from "riding up" on the chain. A foot of this type will prove a handy accessory in the performance of slide fastener work.

The sewing machine manufacturer can supply you with a regular slide fastener presser foot (right or left) for your machine, or one can be made locally. File or grind the left side of an old presser foot to permit sewing within ⅛ inch of the chain.

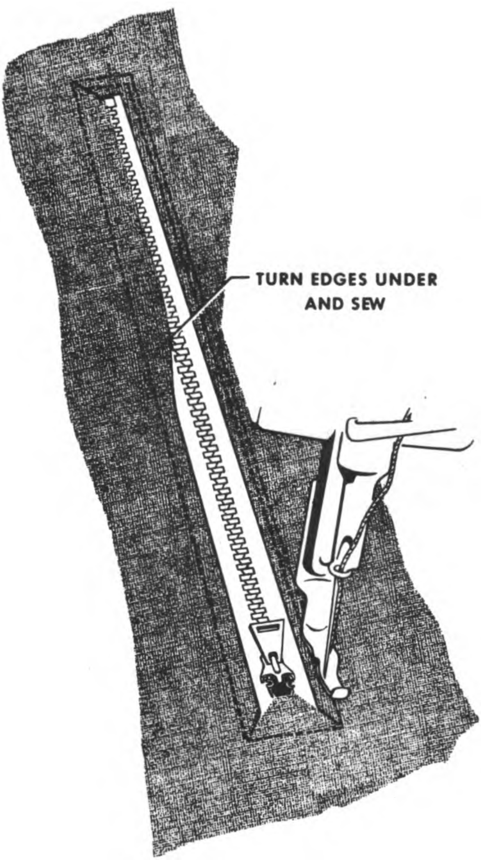


Figure 8—33.—Installation of a slide fastener. Step 3.

When sewing, always stretch the slide fastener and not the material, as this makes a flatter and neater job.

A simple method of installing a slide fastener when making a bag or cover with two closed ends follows: Lay the piece of material right side down, and place the slide fastener right side down on top of the material where the opening is to be located. Sew a row of stitches completely around the outer edges of the tape as shown in figure 8–31.

Turn the material over. Then by feeling with the points of a scissors, cut directly down the center of the chain and snip a V at each end, as shown in figure 8–32.

Turn the edges of the material under, thus exposing the chain. Allow sufficient space so that the slider will not rub the edge of the hems. The V at each end will permit the sewing of neat, square corners. (See fig. 8–33.)

STOCK INFORMATION.—The nonseparating slide fastener tape chain is stocked in bulk rolls of 10-foot minimum lengths in sizes "1" and "3." They are interlocked while carried in stock and will remain interlocked when shipped. The unit of issue is in feet.

The separating slide fasteners (with retainers and separating pins attached) are stocked in size "3" only, and in lengths of 24, 48, 72, and 108 inches. Unit of issue is EACH. Necessary stops and sliders are stocked in bulk. Only the style "L," locking, nonreversible, single pull slider is furnished.

Size "1" medium service and size "3" extra heavy service fasteners are the only two sizes in stock.

Activities should specify the brand of chain for which stops and sliders are required. (Talon, Crown, or any other make.)

Slide fasteners in stock will be supplied in the nearest length ordered. When received, the chain should be cut to the desired length; stops can be salvaged and reused on the cut chain.

QUIZ

1. The Parachute Rigger must be able to set, repair, and renew what type of fasteners?
   - a. Snap fasteners
   - b. Grommets and speedy rivets
   - c. Slide fasteners
   - d. All the above

2. Fasteners, other than those used in parachute manufacture and general utility work, are found in the ASO Catalog under
   - a. Class 27
   - b. Class 83
   - c. Class 42
   - d. Class 32

3. The three-way locking type snap fastener is manufactured in how many sizes?
   - a. 4
   - b. 1
   - c. 3
   - d. 5

4. Lift web keepers of a seat type parachute are equipped with what type of fastener?
   - a. Regular wire spring clamp fastener
   - b. Three-way locking snaps
   - c. Curtain type
   - d. Glove snap type

5. The two vertical keepers which hold the shoulder straps and the back strap are fitted with what type fasteners?
   - a. Slide fasteners
   - b. Curtain type
   - c. Three-way locking snap
   - d. Glove snap

6. When a chuck or die is damaged or lost, how is it replaced?
   - a. Order from ASO stock
   - b. Open Purchase Order
   - c. Section "6" Allowance List
   - d. FASRons

7. The type of grommets used in parachute work are made of metal and are
   - a. round
   - b. square
   - c. oval
   - d. oblong

8. The spur grommet should not be used on
   - a. bunk bottoms
   - b. canvas
   - c. rubberized fabric
   - d. lightweight fabrics

9. Speedy rivets are available in
   - a. 4 sizes
   - b. 3 sizes
   - c. 1 size
   - d. 2 sizes

10. Most slide fastener trouble may be traced to a
    - a. bent slider
    - b. top stops missing
    - c. bottom stops missing
    - d. torn beading

11. To remove the slider from a regular-type slide fastener you should
    - a. rip the stiches from the top of the slide fastener
    - b. force it off
    - c. rip the stitches from the bottom of the slide fastener
    - d. cut it off

12. To remove the slider from a separating-type slide fastener you should
    - a. rip the stitches from the top of the slide fastener
    - b. rip the stitches from the bottom of the slide fastener
    - c. cut it off
    - d. rip the stitches from the top of the slide fastener on the retainer side only

13. What type is the separating, single action slide fastener?
    - a. Type A
    - b. Type B
    - c. Type S
    - d. Type L

14. What size of slide fastener would you use for heavy service?
    - a. Size 4
    - b. Size 0
    - c. Size 2
    - d. Size 3

15. The unit of issue for nonseparating slide fasteners is
    - a. each
    - b. inches
    - c. bulk rolls of 10-foot minimum
    - d. feet

16. The unit of issue for a separating slide fastener is
    a. feet
    b. inches
    c. each
    d. bulk

17. Separating-type slide fasteners are stocked only in size
    a. 4
    b. 2
    c. 1
    d. 3

18. Nonseparating slide fasteners are stocked in sizes
    a. 2 and 3
    b. 1 and 3
    c. 3 and 4
    d. 1 and 2

19. The distance from the stops of a slide fastener to the ends of the tape should be approximately
    a. 1½ inches
    b. 2 inches
    c. 1 inch
    d. ¾ inch

20. What tool can be used to close a slide fastener?
    a. Nippers
    b. Bent awl
    c. Stop closing pliers
    d. Pull-up pliers

CHAPTER 9

MAINTENANCE AND MINOR REPAIRS

The term MINOR REPAIR applies to such operations as replacing container assemblies, pack-opening bands, parachute harness assemblies (when no sewing is involved), pilot-parachute assemblies, vent rings, repairs to containers, certain repairs in stitching, and repairs to torn places or holes in the canopy which do not exceed 8 inches in length or diameter. Such minor repairs can be accomplished by qualified personnel and with proper equipment.

Parachutes are forwarded to the nearest major repair station for complete inspection and overhaul only as warranted by their condition, the extent of repairs required, or the lack of local MINOR REPAIR facilities.

The satisfactory repair of parachutes involves an understanding of the proper methods and materials to be employed for the repair and a conscientious application of this knowledge. In making repairs the Parachute Rigger can be guided in details, to a great extent, by the construction of the parachute being repaired which serves as a convenient and practical model. All replacement materials, hems, seams, stitches, and thread must be standard, and identical with original details of the part being repaired.

In cases where more specific information is necessary, consult applicable drawings or blueprints which cover the construction of the parts involved.

Parachute blueprints for the Navy are prepared at the Naval Aircraft Factory, Naval Air Material Center, Philadelphia, Pennsylvania. Copies of these blueprints and specifications are available through supply channels. Consult your Supply or Publications Officer for the proper method of procuring any specific type of publication. Major repair bases make arrangements with publication distribution depots and are on the mailing list to receive all blueprints, specifications, and other publications connected with their work. Technical publications distributed by the Bureau of Aeronautics to shore-based and fleet activities contain drawings or photographs when necessary to convey a more accurate picture of the specific change in equipment or procedure; COMAIRLANT and COMAIRPAC directives do the same where possible.

BLUEPRINTS

A blueprint is a photographic print of a drawing, white on a bright blue background. It is an exact reproduction of the original drawing.

How much authority does a blueprint carry and to whom?

Naval Aircraft Factory parachute blueprints clearly define the materials, dimensions, type and number of stitches, rows of stitches, types of seams and hems, and all the other information necessary for a manufacturer to fabricate each subassembly into a complete parachute. Government inspectors are assigned duty in each industrial plant to insure a strict compliance with the materials, dimensions, and other specifications set forth in the blueprints and manufacturing contracts. The blueprint is, therefore, a commanding factor in the initial stages of the production of any product for the Navy. As long as a particular product remains in use, so will the blueprint. It is only through the actual use of a product that we discover its weaknesses and take steps to correct them.

The original blueprint may be revised many times. New and stronger materials replace the old, and processes change. Each new development constitutes a revision to the original. The latest revision is a reflection of a combination of things; namely, mistakes and improvements to fit the need. The blueprint acts as the base reference, and when something goes radically wrong we must return to the particular base reference for repairs or take steps to replace the original with something new and superior.

TITLE BLOCK.—The title block, located in the lower right corner of NAF blueprints, contains the title of the blueprint (Harness Parachute Back Type NB3–R) and number (605509).

REVISION NUMBERS.—Revision numbers appear on the blueprints to the left of the title block in the order and date of each revision.

STOCK COLUMNS.—Stock columns appear on the blueprints above the title block, and list the materials, quantity, and specifications for each subassembly.

BLUEPRINT NOTES.—Blueprint notes are located in the upper right corner of NAF blueprints and indicate special instructions for the fabrication of the entire assembly, such as machine stitching, number of stitches per inch, marking instructions, and limits.

Subassemblies

The subassemblies are indicated by dash numbers (–2, –3 etc.). The subassembly is only a part of the entire overall assembly.

The parachute manufacturer must carefully follow all dimensional figures. He is required to manufacture items within the tolerances established in the design, applying the same care as a manufacturer of machinery.

The Parachute Rigger can often copy from the actual subassembly when fabricating a minor item like a ripcord grip pocket, a back pad cover, seat cushion cover, or harness keeper, provided a blueprint is not available and the Rigger is certain the work he is copying is correct. For information relative to seams and stitching refer to chapter 10.

BLUEPRINT READING.—It doesn't take an expert to effectively read a parachute blueprint. You can learn to do it by practice and by studying the applicable chapters in the NAVY TRAINING COURSE, *Blueprint Reading and Sketching*, NavPers 10077–A. Most BuAer technical publications directing a change in a specific piece of equipment or procedure are illustrated with a photograph or series of photographs. The photograph has the advantage of showing the overall relationship in a more familiar and acceptable way than a drawing. However, a drawing becomes necessary when greater detail is required, where dimensions, figures, hidden views, etc., must be shown in order to accomplish the objective. The type of drawing illustrating a technical publication is usually very simple and is easily understood.

LAYING OUT MATERIALS

Layout is the placing of lines on the material to correspond to the lines and dimensions of the blueprint or the actual item being copied. The layout includes object outlines and centerlines. Hidden lines, dimensions, and notes are not written on the layout. Layouts are full size and must be measured and marked accurately. Limits and allowances must be observed.

To locate, measure, and mark the layout accurately, you need to know two things: First, how to follow a good layout procedure step by step; and second, how to use precision layout tools, and how to keep them in excellent condition.

If you follow the drawings or accurately transfer dimensions from a model, learn the procedure, use your layout tools properly, and keep the material flat, you will have no trouble with layout work.

Measuring

A number of tools, common to the Parachute Riggers, used for laying out, marking, and cutting fabrics are illustrated in figure 9–1.

Always square off the end of the material before attempting to measure it. Plan straight construction projects so that the warp threads of the material will be in a position to properly absorb any longitudinal stress played upon it. For example, a small-arms gun cover is better designed with the warp threads paralleling the length of the gun barrel, as the forces acting upon the cover during the process of placing it over a gun are mainly longitudinal.

There are other considerations besides the strength and absorption factors to be remembered when laying out material for measurement. Utilize the length of material when-

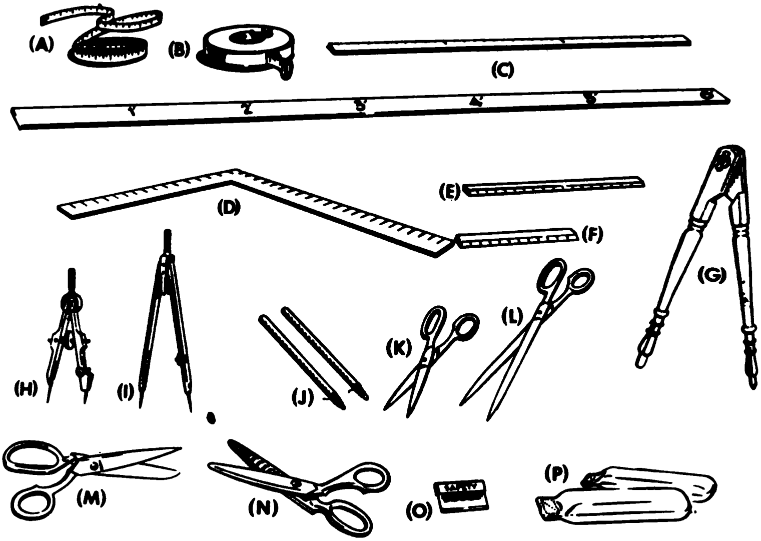


Figure 9–1.—Laying out, marking, and cutting tools.

(A) Six-foot measuring tape.
(B) Fifty-foot measuring tape.
(C) Yardstick and six-foot straightedge.
(D) 24-inch square.
(E) 18-inch rule.
(F) 12-inch rule.
(G) Large chalk holding compass.
(H) Small pencil compass.
(I) Dividers.
(J) Pencils, white and black (wax type).
(K) Scissors, 6-inch.
(L) Shears, 10-inch.
(M) Shears, bent-trimmers, 12-inch.
(N) Shears, pinking.
(O) Razor blade.
(P) Weights.

ever possible in order to conserve the material and save wasting needless quantities. Avoid cross seams in small projects involving lengths under 9 feet. The more you design seams into a project, the more will be the need for additional yardage. Take full advantage of the selvage edge which is woven to prevent raveling. Using the selvage edge wisely can speed up a project, as this edge is prefinished and will not require binding or a hem in places where strength is not important. Placing two selvage edges together, as in making a seam, will add to the strength of that seam and permit a closer edge-run of stitches than ordinarily possible with two raw cut edges.

RULES AND YARDSTICKS.—Do not make measurements from the end of the rule or yardstick. The ends tend to wear off, so always measure from the one-inch mark. Work where you will have the best light, being sure you can see the marks on the rule and the layout. When you mark off a dimension, check it with your rule immediately. Be sure the mark is correct before you make another measurement. Make allowances for seams and hems. Some blueprints indicate seam and hem allowances.

The rule is also used to check the part as it is being made. Therefore, when the part is completed, it will have been checked in all possible ways, and will be within the specified limits.

STRAIGHTEDGE.—A straightedge is similar to a yardstick, but is longer and has no graduation marks. A straightedge cannot be used for measuring, only for marking straight layout lines. Keep the straightedge in good condition, and you will always have a reliable guide for marking long, straight lines, and for checking flat surfaces.

DIVIDERS.—Dividers are precision instruments and are more commonly used by machinists than by Parachute Riggers. However, there are times when they can prove useful, as in checking short obstructed distances that cannot be measured with a rule. The dimension is actually transferred directly from the object to the layout by adjusting the "spread" of the instrument to correspond with the object's dimension and then applying the dimension to a layout.

SQUARES.—Squares are used to draw angles. Most of the time you will use squares to make layout lines at right angles (90°) to squared edges; but occasionally the lines will be at angles other than 90°. For large material sections, use the 24 x 16 inch steel square.

When using a square, lay the short or long part of the square flat along a straight edge of the canvas or material. Hold the square tightly against the surface while marking.

Handle squares, and all measuring instruments, with care. If they are dented, cracked, or sprung, their usefulness is lost. Do not drop them or throw them in a drawer or tool box.

COMPASS.—For jobs requiring large arcs and circles, a large chalk compass will do the job adequately, providing there is some means of "fixing" the adjustment so it cannot slip. When using the compass, incline it in the direction of the arc or circle. Do not lift the compass point from the center. Try to draw a circle in one continuous motion. Remember to make allowances for seams.

Before placing a mark on a piece of material always make sure it is lying flat and the warp and filler threads are running in the proper direction. Lightweight materials are more difficult to mark, and consequently may require a pattern application.

Marking

PENCILS.—Use a colored wax pencil which will contrast with the material. The markings should stand out sufficiently, offering substantial guidelines for cutting. A carpenter's flat lead pencil will also serve as a reliable marker, but its use is limited to the lighter colored materials. Sharp pointed pencils will tend to tear certain materials and the points are easily broken. Before attempting to use a newly sharpened pencil, dull the point. The heavier wax pencils can be sharpened in a flat and narrow pattern to make marking easier and to prevent breaking the point.

Before marking a line, allow for the thickness of the pencil's point. Place the pencil on the starting mark and then bring the rule or straightedge in contact with the pencil. Hold the straightedge on the first mark, allowance having been made for the pencil's point, shift the pencil to the second mark and align the corresponding point of the straightedge with it. After making certain that both marks are in correct position in relation to the straightedge and the pencil's thickness, draw the line lightly but heavy enough to be seen easily.

Small weights, similar in appearance to shot bags, or covered lead weights, are handy for holding the material down while certain types of layouts are being marked off.

Mark deep nap material with a regular tailor's chalk. Tailor's chalk comes in a flat tapered edge form. It is particularly suitable for marking alteration lines on flight clothing, especially when fitting the garment.

Cutting

Bent-trimmers shears are designed to cut material lying flat on a table. They are not made or intended for general utility work. A Parachute Rigger should carry a small pair of scissors on his person for general use. A pair of dull shears or scissors will tear and pull the threads along the cut making a ragged edge. Sharpen your scissors frequently. A sharp pair of scissors will cut to the tips of the blades.

To commence cutting, apply the shears about half open. Make one cut or snip, then slightly open the blade and glide the shears forward. It isn't necessary to open and close the blades, completing each cut as you go. Simply start the cut as described and then push the partly opened shears along a cutting line, stopping just before the opposite edge or any line is reached. Now, as in the beginning, close the blades. Remember to close the blades when starting or finishing. If you do not close the shear blades on the first and last cuts of the operation, the material may pull and a ragged edge will result.

Before starting to cut, make certain that you have allowed a sufficient margin for all the seams.

Make a habit of cutting material on a bare, smooth-topped table. You may accidently damage the bottom piece of material if you attempt to cut a layout while it is placed over another piece.

Do not drop or otherwise mishandle a pair of shears or scissors. The blades are easily sprung out of alignment.

Patterns and Templates

PATTERNS.—A pattern is a guide or model for making things, as a dressmaker's pattern. The Parachute Rigger isn't expected to make a dress, but he is expected to make repairs to a part or section of a flight suit. A pattern can be constructed from a damaged facepiece of a flight suit, using the damaged part as a model to construct the pattern.

TEMPLATE.—A template is a gage, pattern, or mold usually made of sheet steel. It is permissible to construct a fiber template (using a stiff fiber board material) for local fabric use where production is limited. A template is used in production work as a guide for making a number of duplicate parts. The measurements on templates must be made accurately. If the template is wrong, all parts made from it are wrong.

The procedure followed in making a template is essentially the same as that used in making a layout. Templates used by major repair activities are usually made of sheet steel to withstand the wear and tear of shop use. In spite of the sturdy metal, templates become damaged or inaccurate from use. Do not work with an inaccurate template. Periodically check the accuracy of the template's dimensions with applicable measuring instruments.

A template will include the seam dimensions. It can be made from blueprints or an actual model of the item to be constructed. The measurements on a template MUST be accurate. Figure 9–2 illustrates the use of a template for the main flat pattern of a parachute container. Notice the holes which permit marking the depths of the cuts for the corner

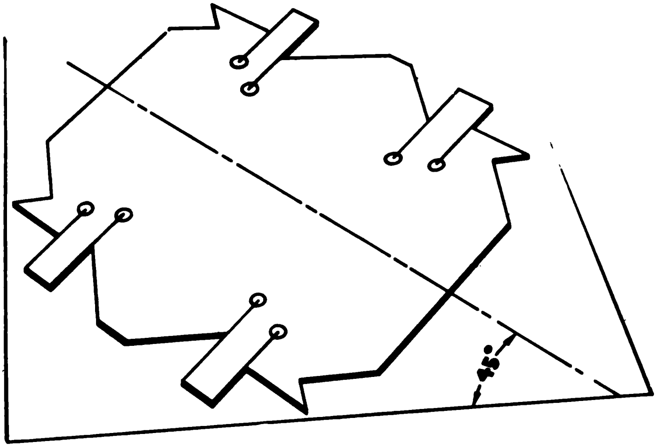


Figure 9–2.—Template in position; project ready for marking.

flaps. The template is placed on the material at a 45° angle to the centerline of the width of the material. This is bias construction which will permit the greater amount of elasticity needed by the flat pattern of a parachute container.

MINOR REPAIRS

Patching, Replacements, Reconditioning

Patching the canopy.—The canopy cloth of parachutes (ripstop nylon, type I) has a breaking strength of 40 pounds per inch of width, warp, and filler, while the tear resistance or the amount of force required to continue a tear once started is only 3.5 pounds. Small tears, holes, snags, broken threads, seam separations, etc. jeopardize the safety of the parachute and must be repaired. Small snags and broken threads may sometimes be successfully darned. However, darning should be used on very small damaged areas only. See "Hand Sewing" which is discussed later in this chapter.

Thread separations are often found in the canopy material, especially at the seams, and particularly if the canopy material is twill woven. The thread separations are usually the result of careless, rough handling, or from strains in drop testing. If threads are not broken and the damage is not severe, thread separations may be repaired by pushing threads back into place with a pencil eraser or soft brush. Be careful to note on which side of the separation the threads are embedded. If the damaged area is brushed in the wrong direction, thread separations will be increased.

Rust, mildew, and acid stains will spread throughout the canopy cloth and must either be neutralized or cut out entirely. If the area is determined to have been mildewed, the best way for removal of the mildew is by washing the area with a MILD SOAP and water. Mildew has little effect on nylon and will not form unless some other feeding media is present. Rust stains cannot be neutralized or removed with approved cleaning agents. They must be cut out with at least a one-half inch border beyond the stained area. Regions deteriorated by acid shall be cut out with a one-inch border around the affected area, but if the area is greater than 8 square inches the entire section must be replaced. If acid effects a stain on any radial seam, skirt hem, vent hem, or suspension line, the canopy must be turned in for overhaul. STAINS NOT RECOGNIZABLE SHALL BE NOTED IN THE PARACHUTE RECORDS. Stains that are judged harmful because of their visible deteriorating effects to the material must be patched. Most grease and oil stains can be wholly or partially removed by applying a cleaning solvent.

One of the major principles to be observed in mending rips, snags, tears, and holes in material is to place the patches in such a position that the warp and filling threads of the patches will lie parallel to the warp and filling threads of the canopy. The warp threads of the material run lengthwise of the fabric, therefore are parallel to the selvages. In the absence of selvages for guidance, the filling threads may ordinarily be recognized by their greater coarseness and smaller number to the inch as compared with warp threads. Both sets of threads meet the centerline of the gore at an angle of 45°, and the warp threads are always parallel to the diagonal seams. The purpose of this precaution is to assure that the elasticity of the patch will be the same and in the same direction as in the material to which it is applied. In this way the patch will be less subject to distortion and subsequent damage under the shock of opening. Another important principle is: Always try to anchor the patch to a seam, or if possible, to two seams. A patch so applied possesses greater strength and is less likely to weaken the material to which it is applied.

Double patch.—When the damaged area is not badly frayed, baseball stitch the tear as shown in figure 9–3. Do not draw the baseball stitches too tight, thereby puckering the area. In producing a smooth finish, maintain just enough tension on the stitches to bring the separated edges together.

Use a double patch for most repairs; that is, one patch inside the canopy and the other patch outside. The inside patch shall be the smaller and must be applied first so that its stitching will be covered by the outside patch. The raw edges of a patch shall be turned under ½ inch.

Large holes or tears require a double patch, one inside and one outside. After turning under ½ inch on all sides, the inside patch should be large enough to allow a 1-inch minimum margin on a 1-inch to 3-inch puncture; a 1½-inch minimum margin on a 3-inch to 6-inch puncture; and a 2-inch minimum margin on a hole from 6 to 8 inches. Regardless

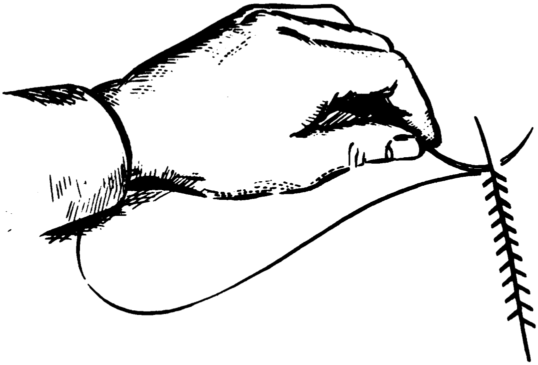


Figure 9–3.—The baseball stitch.

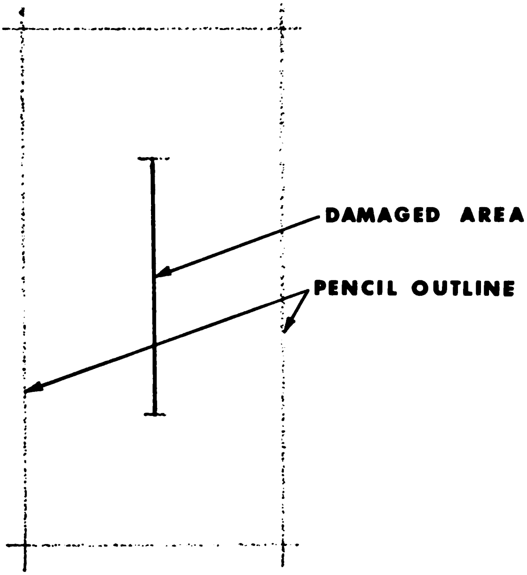


Figure 9–4.—Lightly outline the damaged area.

of the hole size the outside patch must be larger than the inside one.

Using a soft lead pencil, lightly outline the area to which the patch will be sewed. Be sure to allow the correct minimum margin in relation to the perimeter of the finished or TURNED UNDER EDGE of the patch while marking and following the line of the weave around the damaged area. (See fig. 9–4.) Place the piece of new material with the weave correctly matched, warp for warp, filler thread for filler thread, over the outlined area. The material is very sheer and the penciled lines may be seen through the patching. Taking a pair of sharp scissors cut the patch to a size ½ inch larger overall than the penciled lines, the extra half inch being allowed for the hem.

In order to cut straight with the weave, it is advisable to pull a thread where the cut is to be made. (See fig. 9–5.)

Use the inside patch as a gage when cutting the outside patch. Place the inside patch on a piece of new material.

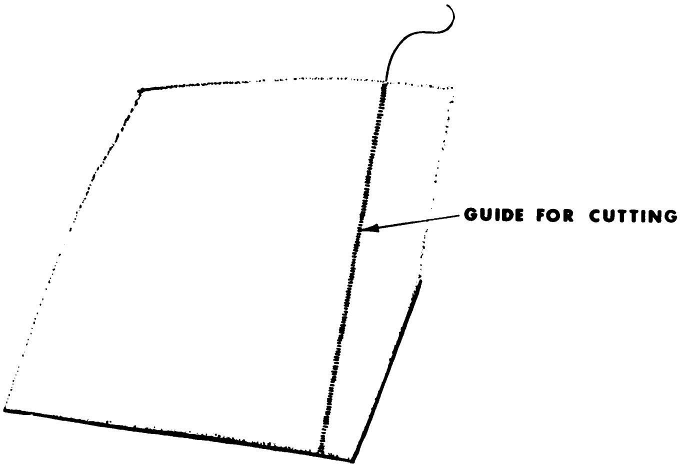


Figure 9–5.—Pull a thread from the weave to use as a guide line for cutting.

Cut the new material ¼ of an inch larger than the raw-edged perimeter of the inside patch.

Turn the edges of the inside patch under ½ inch. Baste or press the hem so it will stay in place when the patch is being sewed to the inside of the canopy. Apply the inside patch, sewing one row of stitches ¹⁄₁₆ of an inch from the edges.

Turn the edges of the outside patch under ½ inch. Baste or press the hem so it will stay in place.

Locate the outside patch over the inside patch so that their margins are even all the way around. A beginner will do well to baste the outside patch in place before attempting to sew it by machine. Sew one row of stitches around the outside patch edges ¹⁄₁₆ of an inch. Sew the second row of stitches ⅜ of an inch in from the edge row. Figure 9–6 diagrams this operation.

A badly frayed hole, if allowed to remain within a patch, may tend to roll or bunch, and will cause wrinkles. Accordingly, the damage must be trimmed to a rectangular shape. If the trimmed damaged area exceeds 8 inches across

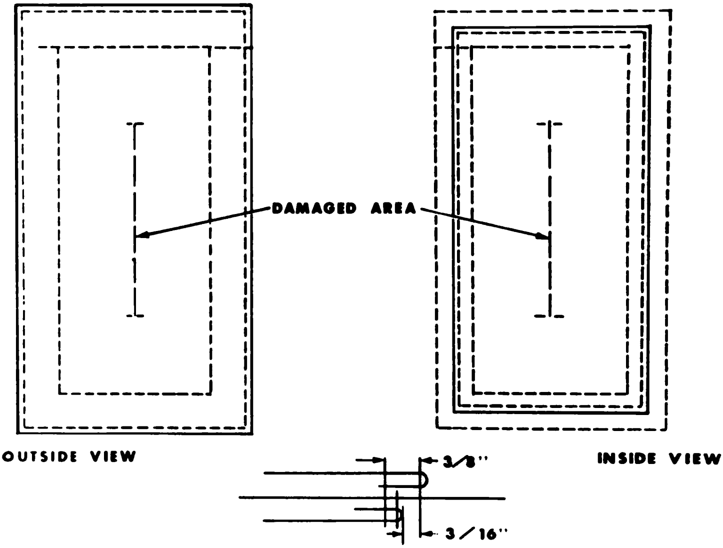


Figure 9–6.—Double patch applied to a canopy section.

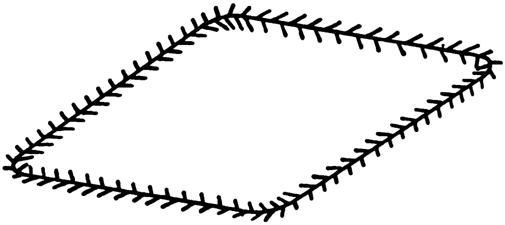


Figure 9–7.—Filler patch applied.

its widest dimension, the repair must be considered major and must not be undertaken locally.

After the material has been trimmed and rounded at the corners to prevent tearing, apply a filler patch as illustrated in figure 9–7. The filler patch merely acts as a binder to hold all of the separated edges together and prevents objectionable wrinkling.

After the filler patch, apply the inside patch, observing

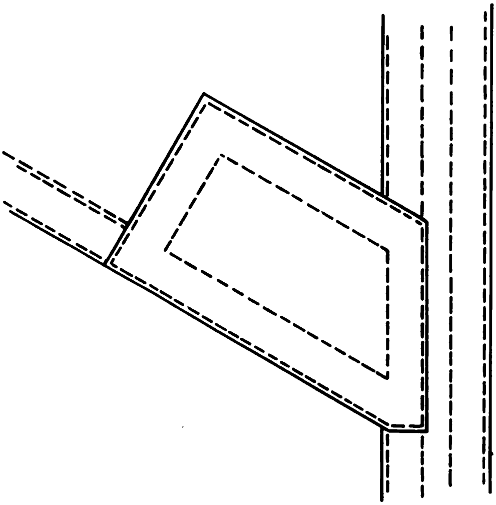


Figure 9–8.—Double patch anchored to seams.

the same general rules as outlined for marginal allowances. Then apply the outside patch.

For additional strength, always try to anchor one or more sides of the patch to a seam or hem. NEVER sew through a suspension line. Where it is feasible to anchor the patch to a seam, the dimension of the patch may be extended on the applicable side. Figure 9–8 illustrates a patch anchored to a radial and a diagonal seam.

SINGLE OUTSIDE PATCH.—If the hole is one inch or less, use a single outside patch as diagrammed in figures 9–9, 9–10, and 9–11. The patch should be large enough to leave a margin of at least ½ INCH around the borders of the hole. (See fig. 9–9.)

In applying a single patch, and using a lockstitch, sew two rows of stitching around the edges ⅜ inch apart. Use size "E" nylon thread, 8 to 10 stitches per inch, for sewing ALL PATCHES and other repair work on the canopy.

Holes larger than 8 square inches shall not be patched. Only two single or one double patch shall be allowed per section.

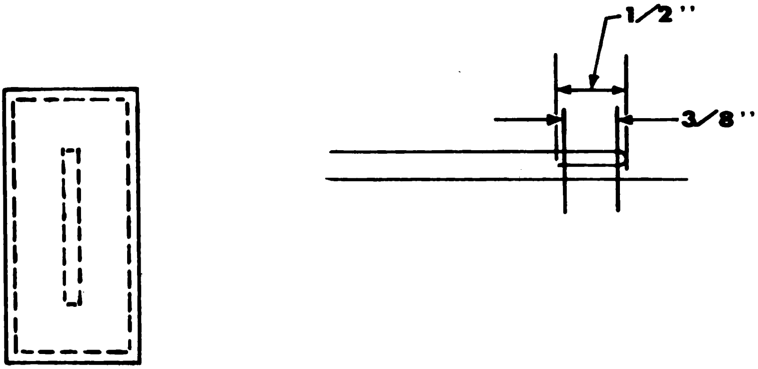


Figure 9–9.—Single outside patch applied to canopy section.

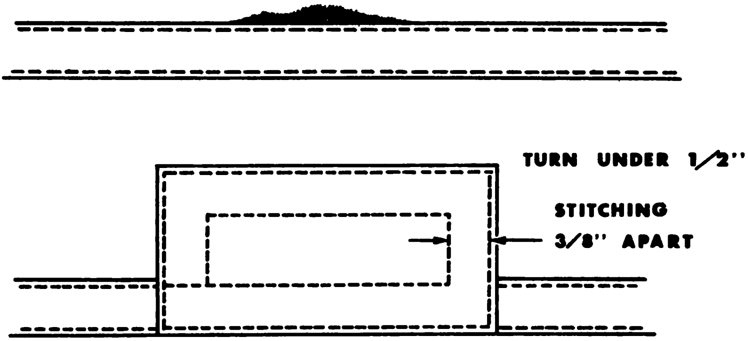


Figure 9–10.—Single outside patch applied to one side of a diagonal seam.

Cut the thread or the stitching as infrequently as possible. When the stitching of a seam has been connected, backstitch for at least 2½ inches on radial seams or hems and 1¼ inches on the diagonal seams. If a patch is not anchored to a seam or hem, it shall be backstitched 1¼ inches.

Where it is difficult to decide on a definite repair due to an overall deteriorated condition or damaged canopy, prepare the parachute for major overhaul.

The material used in the repair of canopies shall be the same as that in the original canopy.

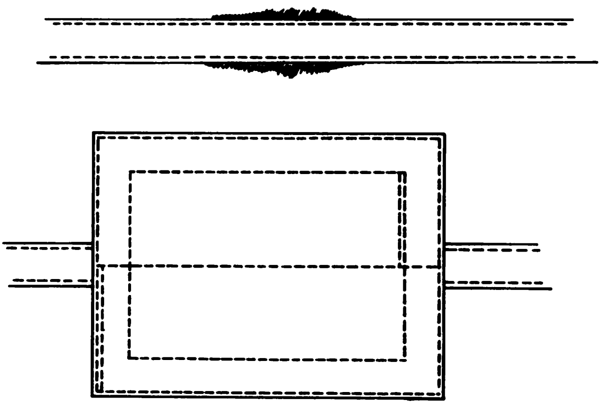


Figure 9–11.—Single outside patch applied to a diagonal seam.

Misplaced or slipped threads in the weave of the material very often may be brushed back into place and a patch will not be required. Whenever several threads are broken they should be reinforced with a patch as indicated in figures 9–9, 9–10, and 9–11.

Replacing the rubber-vent ring.—Broken rubbers cannot be repaired. Damaged vent rings must be replaced. To replace the rubber-vent ring, open the hem, remove the old ring, insert the new ring, and resew the hem.

Harness.—Parachute harnesses requiring repair work other than the correction of several (7 or 8) broken or defective stitches, except in the lift web to link sewing, shall be replaced by a new or serviceable harness. The only exception is in the end of the lift web sewing where it is connected to the links and where no defects are permitted. THERE SHALL BE NO DEFECTIVE STITCHING IN THE LIFT WEB TO LINK SEWING. Applicable technical publications shall be reviewed for instructions on various valid modifications to be made to existing harnesses to convert them to the latest specifications. Before making any modification, always check to be certain that it hasn't been cancelled or superseded by a later directive.

Harnesses are currently issued with lift webs presewed for the convenience of installing them in the field. Of all stitchings, the connective ones are the most important to security.

PACKS OR CONTAINERS.—Reconditioning of the container can be accomplished with or without a sewing machine. In no case shall any patches, modification, additions, attaching of cushions or life-raft cases, or other repairs of any nature be made to the container while the parachute is packed therein. To do so is to risk the possibility of accidentally securing the suspension lines, pilot chute, or the main canopy to the container and thereby slowing or preventing the release of the parachute in an emergency. Tears and rips in the material shall be repaired with a single outside patch turned under a half inch at the edges. Corners and edges of the container chafed by the metal frame should be reinforced with 1,800-pound nylon webbing. Do not use light herringbone tape for this purpose.

At the first appearance of acid stains on a pack, the parachute shall be unpacked immediately and the canopy examined for similar damage. The affected portion of the container shall be cut out and an outside patch shall be applied provided the area is not excessively large. The entire container shall be replaced if the affected area is too large (consistent with good judgment) or if the stains are numerous. The canopy shall be inspected and repaired, if necessary, as previously described.

If the stitches securing the suspension line loops to the false bottom have been broken, the stitching may be replaced, provided the material of the false bottom has not been damaged to the extent that the new stitches will not hold securely. In the latter case the false bottom shall be replaced by a new one. If the tape of the suspension line loops has been torn, it shall be replaced by a new tape and shall not be patched or mended. A piece of 1½-inch nylon tape shall be cut and sewed to the false bottom so that the distance between the rows of stitches as measured on the false bottom corresponds to the distance between the rows of stitches on the original pack. The length of the tape between adjacent rows of stitches is 2⅝ inches for 28-foot canopies. When the parachute is being deployed, it is of utmost importance that the suspension lines be permitted to pay out of the loops freely. Consequently in repairing suspension line loops, great care must be exercised to insure that the patches, heavy stitches, loose thread ends, or other obstructions do not prevent free emergence of the suspension lines. If the loops become enlarged to such an extent that they do not firmly hold the suspension lines in place, they shall be renewed. Original details of manufacture should be noted and reproduced as closely as possible.

The two short lengths of webbing sewed to the bottom of the container and which secure the pack to the harness frequently rip loose and must be replaced. The container thus damaged does not offer a secure attachment and must be reinforced by a patch placed on the inside of the container. This reinforcement patch should be of like material and be 2 inches longer and 2 inches wider than the webbing.

Defective or missing grommets must be replaced, using special dies. When a grommet has torn out of its fastening, it will be necessary to reinforce the damaged place with a nylon patch or with tape or light webbing, as the case requires, before replacing the grommet. It will be necessary to cut away the torn parts before applying the reinforcement so that the thickness around the grommet will not be increased to such an extent as to prevent the locking pins from passing through the holes in the cones. Care shall be taken that the inner edges of the grommets are perfectly smooth and rounded so as not to obstruct the operation of the locking pins or retard the action of the grommets in slipping off the cones.

When cones have become corroded, have bent or broken flanges, or are worn where the grommets or tab ends bear, they shall be replaced. In replacing cones on the container, sew with double 3-cord nylon thread. (Note the way other cones are sewed and follow the same sewing pattern.) Be sure the ripcord pinholes in the cones are in line with each other and also in line with the direction of ripcord pull.

In replacing loose or lost eyes, sew with double 3-cord nylon thread. (Note the way the other eyes are stitched and follow the same procedure.) It will be noticed that at each point of stitching, five turns of the doubled thread are used. It doesn't matter in which order the stitches are made. Finish with the thread on the underside of the container and tie off.

PILOT CHUTE.—If the pilot chute has deteriorated to such an extent that repairs are impractical and uneconomical, or may impair the efficiency of operation, a complete new pilot chute shall be substituted. If the spring is weak or defective, or if evidence of general deterioration is observed, the entire pilot chute assembly shall be replaced by a new or serviceable one.

Tears, holes, or chafed places in the canopy of the pilot parachute shall be repaired in accordance with the instructions detailed for repairs to the main canopy.

Replace missing tacking threads which hold the spring in place.

RENEWING THE TIE CORD.—When the tie cord has to be replaced and the old tie cord does not correctly separate the suspension lines of the main canopy at the peak, the canopy should be laid out on the packing table with the gore having the nameplate uppermost. Take a position on the left-hand side of the table. Then looking along the table toward the hooks at the end, trace No. 1 suspension line to the point where it emerges from the vent of the canopy. Still looking toward the hooks, count out 14 lines, including No. 1, that emerge successively from the vent and are on the right-hand side (looking down the table) of No. 1 suspension line. This action forms a loop in the suspension lines at the peak of the canopy, and it should be temporarily placed over a hook or toggle to prevent its entanglement. The tie cord is made from a 42-inch length of ½-inch nylon webbing. Sear each end of the tie cord to prevent fraying. Loop one end of the tie cord through the suspension lines. Pass the other end through the pilot chute suspension line loop and secure the tie cord with the aid of the bowline knots as shown in chapter 2. After tying off, the overall length of the tie cord shall be 21½ inches.

FLIGHT CLOTHING REPAIRS

A naval pilot of today is supplied with an impressive array of flight clothing which requires a minimum amount of maintenance. Part of the Parachute Rigger's job is maintaining pilots' and aircrewmen's flight clothing in a serviceable condition. To do this requires a good basic knowledge of the principles involved in tailoring. Parachute Riggers are not expected to construct a suit of clothing from a bolt of material; they are expected, however, to be able to make repairs and alterations.

What are the basic principles involved in tailoring? The first and major requirement is knowing how to sew by machine as well as by hand. Second, a knowledge of the materials and construction of a garment is necessary to the operator in order for him to properly analyze the scope of damage and the steps to be taken to effect a remedy. Third, the ability to apply the knowledge acquired in the other two requirements and which can be accomplished only by practice and experience.

To become proficient at removing and replacing a sleeve or collar on a pair of coveralls without damage to the other parts of the garment, one must practice the actual operation. Tailoring cannot be learned from a book; there are too many different types of clothing and shapes on which to drape them.

Flight clothing is rarely damaged to the extent that a yoke or piece in the suit has to be replaced. The greater percentage of damage which occurs in ripped seams or small tears in the material is easily repairable. Restitching a seam or applying a small patch is no great task; however, the same principles regarding the similarity of materials apply here as well as to the parachute. Always strive to use identical materials regardless of the type of repair. This rule is mandatory in repairing parachutes.

Warning: When making an alteration or repair, do not stitch through electrical wiring, rubber bladders, or other similar appendages incorporated in certain types of clothing.

Handstitching is seldom done by Parachute Riggers but there will always remain a need for a hand-held needle application of stitching. Machines are not always readily available and often lack the flexibility inherent in handstitching. Many areas still exist in which the handstitch is the best approach to a repair or an assembling step. Realizing these possibilities, a Parachute Rigger should know how to make and where to use a number of the fundamental handstitches.

Fundamental Handstitches

Darning.—Small snags and broken threads may sometimes be successfully darned. However, darning should be used on very small damages only. On a garment or a parachute canopy the snag or broken thread may be repaired by darning across the torn part with fine running stitches, using a fine needle. The thread must be the same color and texture as the material. If possible, use a thread raveled from a seam or the top of a hem of the garment. Do not unravel threads from a parachute canopy; use an identical piece of scrap material. Smooth out the snag or cut away the broken threads from the damaged area. To reinforce, begin darning about ½ inch beyond end of damage. A knot is not necessary as there is no great strain on the darn. Continue sewing with tiny stitches back and forth across the tear, running the rows at right angles to the long dimension of the damage. Keep the rows irregular in length to distribute the strain more evenly. Do not draw the stitches so tightly that the darn puckers. (See fig. 9–12.)

Running stitch.—Small, even amounts of material are taken up and passed over by the needle in the construction of the most versatile of the fundamental stitches. It is not only used as a temporary stitch as in basting, but as a permanent sewing for the securing of a seam for holding tucks and gathers in lightweight flight clothing. For speed in making this stitch, the needle should be worked in and out

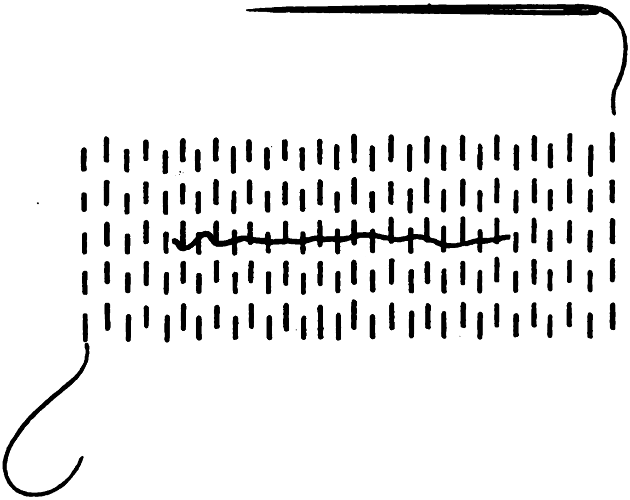


Figure 9–12.—Method of darning a snag or small broken thread area.

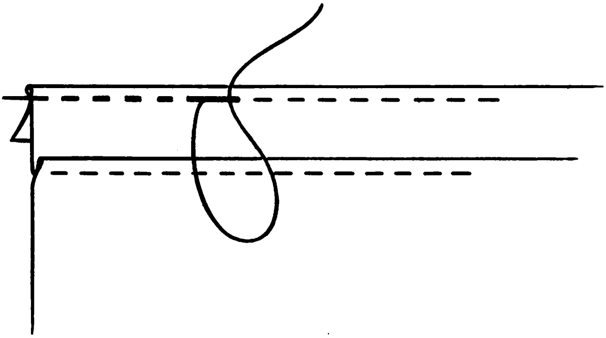


Figure 9–13.—Running stitch.

of the material several times before being removed entirely. (See fig. 9–13.)

Backstitch.—This is a very strong stitching in which there is a space between the stitches on the right side of the material. The wrong side, or underside of the material, will show a continuous run of stitches. There are a few variations of the backstitch, some of which close up the spacing of the stitches on the right side of the material. However,

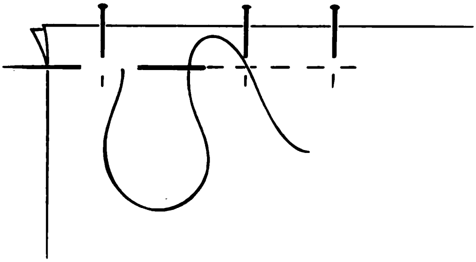


Figure 9–14.—Backstitch.

the method usually used by the Parachute Rigger is as follows: Insert the needle into the material ⅛ of an inch from the right-hand end of the seam. Working from right to left, and from the right side of the material, bring the needle back through the material, coming out of the right side. The amount or length of cloth taken on the first stitch, which should be three times that covered by the stitch on the right side, will govern the size of all subsequent stitches. They should all be evenly made and spaced. After completing the first stitch, which is the long stitch on the wrong side, move the needle back and midway to the point where the needle had been previously inserted. Bring the needle out on the right side, taking up three times the amount of material necessary for one stitch on the right side. Continue taking the long stitch on the wrong side, and the half backstitch on the right side, leaving an equal spacing between stitches. (See fig. 9–14.)

HEMMING.—This is one of the most useful methods of securing the fold or hem turned as the finishing edge of a garment and for securing bindings and facings.

First pin and baste the hem in position on the wrong side of the item. Insert the needle from left to right along the first turned fold, bring the needle out from the fold at the right-hand end of the sewing line. This makes an invisible fastening of the thread. With the needle slanting toward the left shoulder, take up a few threads of the single thickness of fabric directly under the fold, then bring the needle out through the edge of the fold. Moving to the left a very

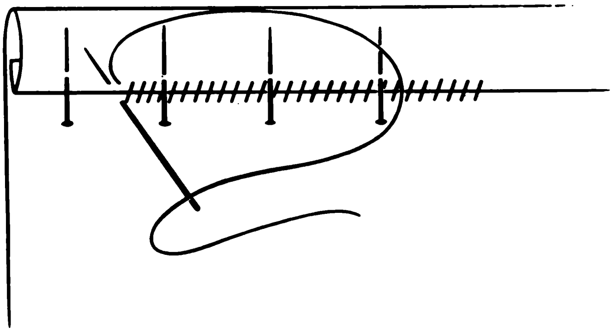


Figure 9–15.—Hemming.

short distance, take another stitch like the one just completed. This makes a slanting stitch on the right side of the garment, and as the sewing progresses toward the left, a slanting stitch is made on the wrong side of the material. The greater the amount of material taken up on the needle and the coarser the needle and thread used, the more conspicuous the stitch will be on the right side of the garment. Fasten off the sewing with two or three minute stitches on top of the last one; then slip the needle from left to right in the fold of the material for an inch or two before cutting off the thread.

When hemming, hold the garment so that the second turning or the edge of the hem is in the left hand, over the first finger of that hand, and the bulk of the material is on a table. (See fig. 9–15.)

Catch stitching.—In this stitch the sewing threads cross each other on the wrong side of the material and one row of small stitches shows on the right side. As a general rule, the stitch is used on the wrong side over unfinished edges in heavy fabrics, especially wool, where a turned-in edge would be bulky and unsightly on the right side.

The catch stitch is one of the few handmade stitches that is worked from left to right. After a raw edge is held in place with pins or basting, insert the needle at the left-hand end of the seam or other line of sewing under the edge of the material to conceal the knot at the end of the sewing thread; then, with the needle held parallel to the raw edge, take a small stitch through the single thickness of material below the edge. Take the next stitch in the material above the raw edge with the needle in the same position, parallel to the cut edge about 1/8 or 1/4 of an inch from and to the right of the first stitch. Take the next stitch below the raw edge and continue alternating the stitches above and below the cut edge. The degree of the angle of the crossed threads is determined by the space between the stitches. (See fig. 9–16.)

Double needle stitch.—The double needle stitch is comparable to a machine stitch; however, the thread used is not locked in the material as it is in the 301 machine type stitch.

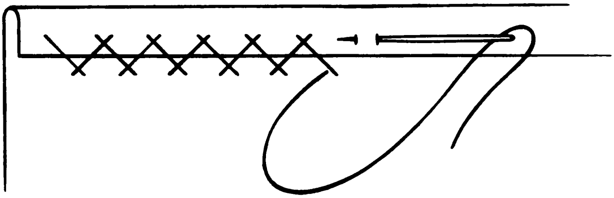


Figure 9–16.—Catch stitch.

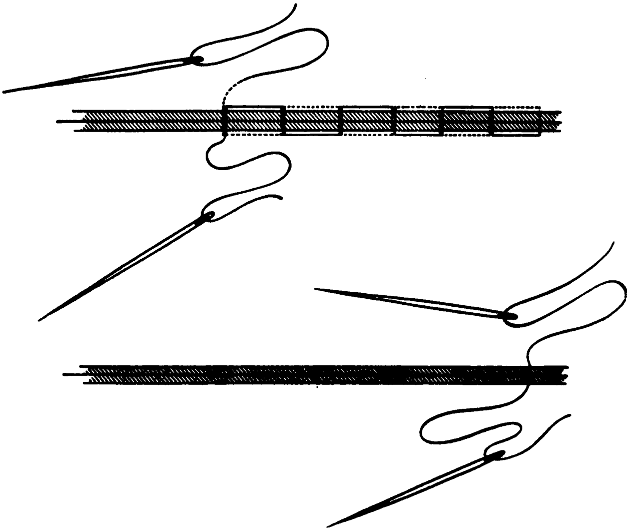


Figure 9–17.—Double needle stitch.

In preparing to sew a series of double needle stitches, thread each end of a length of cord with an appropriate size needle. Pass one of the needles through the material at the starting point. Draw the thread through until half its length is on each side of the material. An awl can be used to make clean holes for both needles to pass through; however, take care not to damage the material. Predetermine the length of stitch, marking the stitches on the material if necessary. Pass one of the needles through the material, drawing the thread up tight enough to lie flat along the surface. As in starting to lace a shoe, be careful not to draw the first stitch unevenly. Pass the other needle through the same hole in the material and in the opposite direction of the first. Be careful not to catch or cut the thread when passing the needles through the material. Continue making stitches by passing each needle through the hole previously made by the other. (See fig. 9–17.)

WORKED BUTTONHOLES.—Wherever possible, this form of fastening is worked through at least two thicknesses of material. The direction in which the buttonhole is cut depends upon the amount of strain which it must withstand in order that it will not spread open and allow the button to come unfastened. The buttonhole is cut parallel to the front closing on the front of a box pleat in a tailored shirt; on cuffs, neckbands, and on belts, it must be cut at a right angle to the ends so that the buttons will stay in place when subjected to strain.

The position for all buttonholes should be marked before they are worked so that there may be no mistake in placement. A paper gage or a tape measure is usually employed for this purpose, and the exact length of each buttonhole marked with pins. Each slash must be a perfectly straight line, and whenever possible, along the straight thread of material. Use a sharp, pointed, small scissors or a buttonhole scissors to cut the slash. The length of the slash is the diameter plus the thickness of the button. To work buttonholes use a single thread slightly heavier than that used to stitch the garment. Buttonhole twist is preferable for wool materials.

Beginners may find the following method helpful in keeping the depth of the buttonhole stitches uniform. On paper draw a rectangle 1/8 inch wide and as long as necessary for the buttonhole. Pin the paper to the garment at the proper location and stitch on the pencil lines. Tear off the paper. Cut directly between the two long stitched lines and diagonally into the four corners. Work the usual buttonhole stitches, inserting the needle on the lines of stitching when making each stitch.

Start making the buttonhole with a knot at the end of the thread and take the first stitch so that the knot is placed about 1/2 inch from the end of the slash on the right side of the material. If a buttonhole with one fan end and one bar end is to be made, start the work at the inner end of the slash where the bar will be placed. The fan end is located at the outer end where the stem of the button will lie. Holding the garment with the right side uppermost and the slash over the first finger of the left hand, place the needle 1/2 inch from the cut. Take 3 or 4 shallow overcasting stitches along the nearer edge to keep the two layers of material from slipping apart while the work is progressing; then turn the work around in the hand and place the same number of overcasting stitches over the edges of that side. Turn the work again to its original position and bring the needle out at the lower right-hand corner of the slash, exactly below the first overcasting stitch and in position to work the buttonhole stitch.

The buttonhole stitches must be slightly deeper than the overcasting stitches in order to cover the latter and to take up enough threads of the material to make a firm buttonhole. The depth of the stitches depends on the texture of the material but is usually from 1/16 inch to 1/18 inch. All stitches must be uniform in size and be evenly spaced.

Take the first stitch by placing the needle in the slash. With the first finger of the left hand hold the thread down as it comes from the material. Then with the right hand draw the double thread from the eye of the needle from right to left placing the thread under the point of the needle to the back or away from you. Draw the needle from the ma-

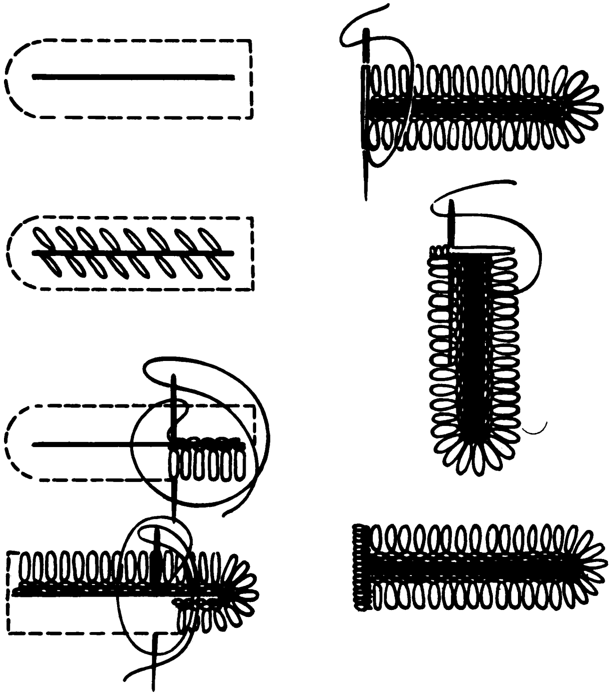


Figure 9–18.—Worked buttonholes with fan and bar ends.

terial and backward toward the first finger of the left hand. This places the purl or double knot exactly on the edge of the slash. Repeat this step until the lower edge of the buttonhole has been covered with these protecting stitches and the left-hand corner of the buttonhole has been reached.

If a fan end is to be made, radiate the buttonhole stitches like the spokes of a wheel so that no crowding of stitches takes place at the end. Five stitches are usually sufficient. The work will have to be turned in the hand as these radiating stitches are taken. When the last one is in place, continue working buttonhole stitches along the other side to the end of the slash.

Place two strands of thread across the end of the buttonhole and at right angles to it to make the bar end first. To do this place the needle in the hole made by the first buttonhole stitch, bringing it out in the hole made by the last buttonhole stitch. Repeat this so that at least two strands of thread are across the end, one on top of the other.

Turn the work so that the buttonhole is at right angles to the first finger of the left hand; then, at the left-hand end of the strands of thread, take a blanket stitch by placing the eye of the needle under the strands of thread and over the thread coming from the material, drawing the needle and thread tightly toward the left. Repeat this step until the strands of thread are completely covered. If preferred, each blanket stitch may be caught in the material. This keeps the purls turned toward the buttonhole. Fasten off the stitch with small stitches on the wrong side of the garment directly under the first buttonhole stitch that was made.

If the double bar buttonhole is desired, work along the first side of the slash as stated; then, instead of making the fan, make one bar before proceeding along the second side of the buttonhole. (See fig. 9–18.)

ENEMIES OF MATERIAL

Synthetic materials, such as nylon, orlon, and dacron, originating from vegetable matter, have one great factor in their favor, the ability to resist the effects of weather. Nylon, the principal material used in manufacturing parachutes and innumerable articles of flight clothing, occupies a commanding lead among materials for fulfilling the needs of the Navy. In view of these facts, some individuals become careless and do not always exercise their best judgment in handling items manufactured from the so called "miracle fibers."

Regardless of the factors favoring nylon with all its reserves of strength, elasticity, and durability, prolonged exposure to the destructive elements of sunlight, salt water, and dirt will dangerously weaken the material, rendering it useless for further use in a parachute. Part of your job is to safeguard the parachute from contact with the aforementioned elements plus evading the destructive qualities of battery acid, oils, greases, mildew, and insects.

DAMAGE SUSTAINED THROUGH CONTACT WITH ACID.—Contamination by acid is probably the most serious damage which can be sustained by parachutes, mainly because the action is rapid and can have far-reaching effects. Unless constant vigilance is maintained for acid detection, contamination and weakening of the parts of the parachute may proceed undetected and might result in serious consequence in the event of emergency use. It is imperative that the utmost care be taken by all personnel to prevent acid from contacting parachute equipment. Only clean vehicles should be used for transporting parachutes in operating units; and particular caution should be observed so that parachutes are not transported in vehicles previously used for transporting wet-cell storage batteries.

Any item of parachute equipment suspected of having been in contact with acid shall be isolated from all other parachute equipment and shall be tested immediately. Similarly, equipment having been in contact with an article known to be contaminated shall be isolated and tested. Not only must the complete article be isolated, but the suspected portions of it shall not be allowed to touch any other portion so that the damage is restricted as far as possible.

To detect the presence of acid follow the instructions set forth in chapter 3.

Whenever definite evidence of acid contamination is found, the damaged parts should be treated immediately with ammonia to neutralize the acid and be allowed to dry thoroughly. A 50-percent solution of 0.880 liquid ammonia and distilled water is recommended, but if not available, ordinary clear domestic ammonia may be used. The solution shall be applied to the affected part with a swab or small piece of sponge tied securely to a stick. Do not be afraid to use an excess of ammonia as this chemical is not injurious to the material or hardware. A bottle of the solution should always be kept in the parachute loft ready for immediate use.

The presence of acid stains on a pack indicates the possibility of serious contamination of the main and pilot chute canopies, and calls for very careful inspection of the whole parachute, including the harness. All packs shall be inspected daily for signs of acid stains, particularly on completion of a flight. The stains can be recognized by their appearance, being putty-colored at first and then changing to white. The stains are more readily discernible on the clean interior of a pack than on the outside, which may be soiled.

If signs of acid stains are noted, the pack shall be opened immediately, the pack put aside and the canopy and pilot chute examined and tested as detailed in the following paragraph. The acid on the pack shall be neutralized to prevent further damage and the pack kept isolated for 10 days and frequently inspected for further signs of contamination, which should be treated as they appear. If, after this period, the damage is small, the affected portion should be neatly cut out and the hole patched; otherwise the pack shall be discarded.

The main canopy and pilot parachute released from a pack contaminated with acid, or known to have been in contact with any piece of equipment suspected of acid contamination, shall be isolated immediately and thoroughly examined and tested for signs of damage. If contaminated areas are discovered, they shall be neutralized at once with ammonia as previously described, care being taken to treat only one thickness of material at a time. If ammonia cannot be obtained, the defective portions shall be carefully cut out and burned. If the contaminated area is 8 square inches or less, it shall be cut out and patched. If the contaminated area is greater than 8 inches, the affected area shall be neutralized and cut out and the entire parachute shall be sent at once to a major repair station for repairs. Should damages of a small area appear on many of the gores of the same parachute, the entire parachute shall be sent to a major repair station for overhaul. Should no signs of damage be found, the canopy shall be hung for 10 days, isolated from all other equipment, and frequently inspected to see whether damage becomes evident. If, after this period, there are still no signs of contamination, the canopy may be put back into service.

Contamination of a harness by acid is more serious than to any other portion of a parachute. A harness so damaged shall be returned to a major repair station for inspection and possible repair or replacement. Harnesses suspected of contamination shall be isolated and tested immediately with litmus paper. Before packing for transport, the parts damaged by acid shall be neutralized with ammonia as already described; or in the absence of ammonia, the damaged parts shall be cut out and burned. When contamination is suspected, but no definite evidence is immediately detectable, the procedure of isolation and frequent examination for a period of 10 days shall be followed. If no damage is detected, the equipment may be put back into service. Whereever any element of doubt exists as to the condition of the harness equipment, it shall be discarded from use, in the interest of safety to personnel.

Examination of even a new parachute canopy will reveal occasional slight displacement of threads of the material especially along or near the seams. Floats, slugs, missing picks, bright picks, setting up places, ends out, etc., which are quite normal conditions in the weave, will also be found. These defects are not detrimental to the strength of the material and need not be corrected. Under no condition should such places be pulled or stretched by hand as such treatment tends to weaken the material and will convert a harmless displacement into a bad strain which will require repair. A strain considered as not warranting a repair should be noted on the canopy chart for the information of the major repair station. When weakness of the material is suspected, the canopy should be sent to a major repair station for inspection and possible test.

Treatment After Immersion in Water

River, lake, or pond water.—If, for any reason, a parachute should fall into natural fresh water, it shall be rinsed as soon as possible in several changes of fresh tap water in a tank or tub and dried. Great care shall be taken to handle the material carefully. The water shall not be wrung out by twisting the fabric parts in the hands, but shall be allowed to drip dry. If a parachute has been immersed in natural fresh water two or more times and there is reason to suspect the material has been weakened, the parachute should be returned to a major repair station for drop testing. The parachute shall be hung to dry in accordance with the procedures previously outlined in chapter 4.

SALT WATER.—It is imperative that parachutes which have fallen into salt water or become wet from perspiration shall be subjected to prolonged rinsings with fresh water before being permitted to dry. The effect of the chlorides on nylon canopies is not severe, but nevertheless, these steps shall be taken. Chlorides in the form of salt, etc., may be deposited upon the canopy by the introduction of salt water, even when the total immersion has not occurred.

The parachute shall be thoroughly washed after any contact with salt water, however small it may be, or upon the appearance of the characteristic stain indicating such contact. Salt can be removed from the material easily, but difficulty will be encountered in removing it completely from the thick parts of the harness. Special attention must be given to those parts where metal fittings are attached, for any remaining traces of salt can result in the start of dangerous corrosive action. The parachute shall be immersed in a bath of fresh tap water for 2 or 3 hours in order for the water to dissolve the salt from the inner fibers of the webbing and the thick areas of seams. For subsequent rinsing, whenever possible, the parachute shall be suspended full length by the vent and a gentle stream of fresh water played on it from a hose.

In cases such as aboard small vessels, when the hose and suspension method cannot be employed, parachutes may be rinsed in a tank or tub under a constant stream of running fresh tap water. The rinsing water may be warm but shall not be hot. Always obtain permission, aboard ship, prior to using large quantities of fresh water. Never wring the water out of the canopy by twisting it with the hands or with mechanical wringers, as this causes objectionable wrinkles in the material and may pull it to dangerous proportions. Exposure to direct rays of the sun adversely affects nylon, tending to reduce its strength and shorten its life. Drying shall be done in the shade, and exposure to the sun shall be avoided. Parachutes which have been immersed in salt water for extended periods of time, or which have been allowed to dry, before rinsing, shall be forwarded to the nearest major repair station for examination and test of materials.

PRECAUTIONS AGAINST RAIN, DEW, AND PERSPIRATION.—Whenever a parachute is in use, it should be protected as much as possible from dampness. Packs and/or harnesses shall not be left in an open cockpit, or anywhere in the open, when there is the least likelihood of rain or heavy dew, nor shall they be placed on wet grass. Before being placed in lockers or other receptacles, packs and/or harnesses should be examined for dampness from rain, dew, or particularly in the tropics, from perspiration. If found to be damp from perspiration, the directions set forth under "SALT WATER" shall be executed. If found to be damp from rain or dew, parachutes shall be released, dried, and replaced.

MILDEW AND FUNGUS GROWTH.—Parachutes are particularly susceptible to mildew in warm humid climates. As the propagation of fungi or mold is dependent to some degree on a nutrient in the material which may be oil, grease, starch, sizing, or other foreign substance, parachutes must be kept as clean as possible. In such locations where mildew is prevalent, parachutes shall be kept in a tight locker or bin, at the bottom of which is placed a suitable container for dispensing naphthalene fumes. Three pounds of napthalene flakes will penetrate the parachute sufficiently to prevent the formation and growth of fungi. Under extreme climatic conditions, approximately ⅛ pound of naphthalene flakes shall be springled over the unpacked parachute within the container or over the folded gores of the canopy prior to the final folding operation when packing the parachute.

Parachutes requiring extensive cleaning shall be forwarded to a major repair station. If the major repair station cannot satisfactorily clean the parachute, it shall be sent to a commercial cleaner for dry cleaning in accordance with established specifications. When forwarding parachutes to a major repair station, a report shall be attached to each parachute describing the nature and location of the stains, and the Parachute History Card, NavAer 2771, shall be completed containing the required information. It is of great assistance when cleaning parachutes to know definitely whether the stains were caused by oil, acids, or other agents.

If the parachutes are not too badly soiled or stained, they may be cleaned by operating units, provided the following directions and precautions are rigidly observed. Soiled parachutes shall be washed with clean, fresh water. The water may be warm but shall not be hot. Sand or dust shall not be brushed off; the parachute shall be thoroughly shaken to remove these foreign substances. If mud is caked and dried on the material, the surface shall not be brushed. The affected area shall be immersed in water, and permitted to soak; the water shall be agitated until the mud is loosened. When dirt and stains are difficult to remove by water alone, an approved dry-cleaning solution may be used. If the harness has been detached, the lines shall be chained together to reduce the length. All metal parts shall be covered with heavy cotton flannel. If the harness has not been detached, it and the attaching hardware shall be placed in a suitable net bag. After washing the parachute in the cleaning mixture, it shall be thoroughly rinsed several times in fresh dry-cleaning solution until the rinsing solution remains clear. The parachute shall then be suspended in the shade to dry.

In removing stains and dirt, the stained area shall be completely immersed in the cleaning mixture and the liquid shall be agitated while the material is held submerged. The flow of the liquid around and through the material will be sufficient to clean it. The material shall not be rubbed together or scrubbed with a brush or cloth saturated with the fluid, as such rough handling damages and weakens it. Prepared commercial cleaning solutions shall not be used since they may cause damage to nylon, which is a synthetic material. The use of inflammable fluids in cleaning nylon parachutes shall be avoided, since nylon has a tendency to collect static charges which may result in a spark that might ignite the fumes. To remove blood stains, the parachute shall be washed in clear, cold water, as warm or hot water will coagulate blood and render it difficult to remove. The use of a "digester," which may be obtained from a dry-cleaning establishment, is recommended in removing blood stains. Drying after cleaning should be done in the shade, in view of the adverse effect of sunlight on the canopy materials. While the above procedure can be carried out by operating activities, provided great care is taken, especially in insuring thorough rinsing, it is strongly recommended that parachutes badly soiled be sent to a major repair station.

STAIN REMOVAL FROM FLIGHT CLOTHING AND RELATED ITEMS

The removal of spots from aircraft upholstery and flight clothing is by no means an easy task or one to be considered lightly. It requires a knowledge of the composition of the material and of the cleaning substance used in order not to damage it irreparably. When in doubt on these points, one should take the garment to a good dry-cleaning establishment and, if possible, tell them what caused the stain.

Any stain which resists the normal washing process is ordinarily removed by "spotting." This is an art and requires great skill in identifying the nature of the stain and in using the proper agent to remove the stain without damaging or otherwise affecting the material, or leaving a ring around the spot from which the stain was removed.

The spotter must be familiar with textile fibers, sizing materials, the dyestuffs used, the stain or spots encountered, the proper agents or chemicals to be used, and their action upon the fibers and dyes. When testing stains, it is advisable to start with the simplest operations, since certain reagents tend to "set" stains, rendering them difficult or impossible to remove.

TYPES OF SPOT REMOVERS.—The usual substances employed for removing stains consists of absorbents, such as fuller's earth, corn meal, and French chalk; bleaches, like hydrogen peroxide, oxalic acid, and Javel water; and solvents in the form of water or liquids, such as a safety solvent, acetone, benzol, or denatured alcohol. Safety solvent is composed of 25 percent methylene chloride (Spec. MIL–D–6998, Grade B), 5 percent of tetrachloroethylene (Spec. O–T–236), and 70 percent of mineral spirits (Spec. TT–T–291 Grade 1). Absorbents are harmless to all fibers and, when spread on the stained material, usually absorb the staining substance. However, they are ineffective except on fresh stains. Because it is difficult to remove all of the absorbent, absorbents used on dark-colored materials should be sprinkled on the wrong side of the material. Bleaches must be used with care since they not only usually remove dye from the material but weaken it if used in too concentrated a form, left too long on the material, and not thoroughly removed. Chlorine bleaches should never be used on wool or silk because they destroy animal fibers. When used on cotton or linen, they should be quickly washed. Safety solvent or denatured alcohol are good for use on stains containing grease. If gasoline, acetone, or naphtha are to be used, the work should be done outdoors because these substances are highly inflammable. Articles being cleansed in these solvents should never be rubbed.

METHODS OF STAIN REMOVAL.—Before using any chemical or water on a stain, try a drop or two on a seam or hem of the garment to test its reaction. Be sure to take this precaution when using a remover containing acetone because this chemical will dissolve rayon acetate. When using water or a solvent, work on the wrong side of the material, placing a white blotting paper or a pad of folded material under it to absorb excess liquid. Change this blotter when it becomes soiled or ceases to absorb. Dip a clean, soft cloth in the solvent and wring it partially dry before brushing it lightly and irregularly over the spot and surrounding material.

When using chemicals, work rapidly, making several brief applications followed by rinsings. After stretching the stained section of the material over a bowl or pad of cloth, apply the chemical with a medicine dropper. After the spot has been removed, dampen a wad of cotton with the cleaning solution and rub with very light strokes in the direction of the grain of the material in order to avoid rings. Dry quickly.

Rayons and other synthetic materials, being generally of cellulosic content, react with chemicals similarly to cottons, but this should not be considered the rule. Other types of synthetic fibers, on the other hand, react like woolens. Generally when wet, rayons and protein fibers are extremely weak and should be handled with extreme care in order to avoid mechanical injury. Contact with organic solvents, such as alcohol, acetone, benzol, chloroform, and glacial acetic acid, will affect the synthetic fiber and must therefore be avoided.

Instructions and suggestions are given for the removal of the more common types of stains in table 9–1.

STENCILING

Parachutes are marked by the manufacturer in accordance with the general specifications for parachutes. In order to speed up and help identify the parachutes of local units it is permissible to stencil certain external appendages with an approved marking fluid.

The rules for stenciling parachutes locally follow:

1. Use currently approved marking fluid.
2. Avoid marking names directly on the equipment; use a length of tape which can be sewed or tacked to the equipment.
3. The exact place to mark and the size of the lettering depends on the equipment and how it is stored.

Table 9–1.—Instructions for the removal of stains.

Stain	Cotton or linen (Vegetable fiber)	Wool or silk (Animal fiber)
Acids	Nitric acid sometimes yellows white textiles. Phosphoric acid (frequently present in sirups) yellows wool. The color of many dyed materials is destroyed by acids. Sponge with dilute ammonia or sodium bicarbonate. Rinse well in water afterwards.	
Alkalies	Alkalies sometimes destroy certain colors. Sponge with dilute acetic acid. Rinse free from acid afterwards. Starch is yellowed by alkalies at high temperatures. Souring will remove such stains.	
Blood	Removed in standard washing process. Javel water removes hemoglobin, the red coloring matter. Stubborn stains may be removed with glacial acetic acid. Be careful of colored materials. Rinse well.	Removed in standard washing process. Sponge with a little hydrogen peroxide to remove last traces.
Chewing gum	Carefully remove mechanically, then spot with safety solvent. Finally wash by hand with soap. Rub well.	
Cocoa, coffee, and chocolate.	Remove in the standard washing process. Residual traces may be removed with oxidizing bleaches.	

Grass	Removed in the standard washing process. Treat last traces with methanol or sodium bisulfite. Cotton and linen only may also be treated with Javel water.	
Grease	Grease stains are usually removed in the standard washing process. If an exceedingly resistant stain is encountered, it may be softened with a mixture of lard and oleic acid (2 parts oleic acid to 98 parts of lard) and washed. When the oleic acid comes in contact with alkali in the usual bath, soap is formed, and being in such intimate association, with the grease, removes it rapidly. Organic solvents may also be used as listed in next column.	Stains surviving the regular laundering process must be treated with an excess of soap by hand or with one of the organic solvents, such as isopropyl alcohol (Spec. MIL–F–5566) and a safety solvent, or Stoddard Solvent. ***Caution:*** Avoid inhaling vapors and use with adequate ventilation.
Gum or resin	Use any of the following solvents: Turpentine, safety solvent, isopropyl alcohol, or kerosene. The specific solvent must be determined by actual test, since the solubility of different gums varies.	
Iodine	Spot with sodium thiosulfate solution and rinse thoroughly.	

Table 9–1.—Instructions for the removal of stains—Continued.

Stain	Cotton or linen (Vegetable fiber)	Wool or silk (Animal fiber)
Machine oil	The stain can be removed only after the manner described under "Grease." If the stain is caused by bearing grease, it may contain some iron and other metal.	
Mildew and mold	Fresh, light stains are removed by standard washing process. Old stains may be treated with Javel water.	Potassium permanganate followed by hydrogen peroxide. Soap and water are satisfactory in very light cases.
Mud	Removed in standard washing process. If an iron residual stain persists, remove as usual with oxalic acid or laundry sour. Rinse well.	
Paint and Varnish	These stains are more easily removed if treated before being laundered. Rub oleic acid into the stain. This is very important, especially for heavy stains. Then soak in an oleic acid-benzine mixture overnight (1 part oleic acid to 3 parts benzine). In the morning wash the material well in hot soda ash solution. The soda ash reacts with the oleic acid to form a "red oil" soap.	Use the following solvents: Turpentine, Stoddard Solvent, and safety solvent. ***Caution:*** Use with adequate ventilation.
Perspiration	If not removed in the standard washing process, treat with Javel water or with potassium permanganate solution followed by oxalic acid.	If the stain does not wash out, use potassium permanganate solution followed by oxalic acid.

4. Identifying marks such as locally assigned numbers must be confined to the back pad and pack. Do not stencil the harness or canopy.

HOW TO STENCIL.—Use an appropriate size (½ inch to 1 inch) adjustable metal stencil. Join each letter properly in the grooves provided. When the stencils are joined, align the letters or figures in order to prevent a wavering line. Use the end plates provided in each kit, which offer the necessary margin to prevent smearing the marking ink off the ends. Hold each letter down tightly as the fluid is applied with a dampened brush. Do not attempt to stencil with a wet brush as the fluid will run off in all directions. Wipe the back of the stencil clean with a dry cloth between each operation. Before storing, clean the adjustable stencils in a safe cleaning solvent.

QUIZ

1. What guide for details could be followed in performing a minor repair to a parachute?
   a. The construction of the parachute being repaired
   b. *Aircraft Accessories Bulletins*
   c. *Aviation Circular Letters*
   d. *Safety and Survival Equipment Handbook*
2. Where does the last revision date on a blueprint appear?
   a. In the title block
   b. To the left of the title block
   c. To the left of the notes
   d. In the blueprint notes
3. Which symbol would indicate a subassembly part number?
   a. –A
   b. (A)
   c. (1)
   d. –2
4. Where will you find the marking instructions on an NAF blueprint?
   a. In the stock column
   b. In the title block
   c. In the subassembly drawing
   d. In the blueprint notes

5. Which tool is used before attempting to measure a piece of fabric?
   a. Pencil
   b. Shears
   c. Square
   d. Compass

6. The main purpose of the selvage edge of material is that it
   a. adds strength to the material
   b. prevents raveling of the material
   c. gives a baseline for layout work
   d. permits closer machine stitching

7. Which tool is used to mark long straight lines?
   a. Dividers
   b. Square
   c. Straightedge
   d. Rule

8. Which item is used as a guide for marking a number of duplicate parts in layout work?
   a. Ruler
   b. Square
   c. Compass
   d. Template

9. What is the tear resistance of type I, ripstop nylon cloth?
   a. 1.1 pounds
   b. 2 pounds
   c. 3.5 pounds
   d. 4.5 pounds

10. What is the breaking strength of type I, ripstop nylon cloth?
    a. 18 pounds
    b. 22 pounds
    c. 40 pounds
    d. 60 pounds

11. Which is the best agent to remove mildew from the canopy?
    a. Mild soap and water
    b. Ammonia
    c. Methyl alcohol
    d. Carbon tetrachloride

12. How is a tear in the canopy prepared for a patch?
    a. Double needle stitched
    b. Backstitched
    c. Baseball stitched
    d. Running stitched

13. The raw edges of a canopy patch must be turned under a minimum of
    a. ⅜ inch
    b. ½ inch
    c. 1 inch
    d. 2 inches

14. The minimum margin required in a 6- to 8-inch canopy tear is
    a. 1 inch
    b. 1½ inches
    c. 2 inches
    d. 3 inches

15. To cut a straight line with the canopy weave, it is advisable to
    a. pull a thread
    b. mark with a wax type pencil
    c. use a square
    d. trust to eyesight

16. What is the distance between the rows of stitches on a canopy patch?
    a. 1/16 inch
    b. ⅜ inch
    c. ½ inch
    d. 1 inch

17. What is the largest hole or tear in the canopy that can be patched in the parachute loft?
    a. 6 inches
    b. 8 inches
    c. 12 inches
    d. 16 inches

18. What is the maximum number of machine stitches per inch allowed on canopy repairs?
    a. 6
    b. 8
    c. 10
    d. 12

19. What size nylon thread is used for canopy repairs?
    a. "B"
    b. "D"
    c. "E"
    d. "E–F"

20. Which thread or cord is used to replace loose cones and eyes on the container?
    a. "E" thread
    b. "E–F" thread
    c. 3 cord
    d. 6 cord

21. What is the overall length of the pilot chute tie cord before attaching?
    a. 18 inches
    b. 21½ inches
    c. 36 inches
    d. 42 inches

22. Which knot is used to attach the pilot chute tie cord?
    a. Surgeons
    b. Square
    c. Bowline
    d. Clove and half hitch

23. Which item is used to neutralize the destructive effects of battery acid on parachutes?
    a. Warm water
    b. Cold water
    c. Ammonia
    d. Cleaning solvent

24. The appearance of acid stains on the parachute container will be
    a. white
    b. brown
    c. red
    d. blue

25. When a parachute has been known to have been in contact with battery acid, you would
    a. survey the parachute
    b. send it to Overhaul and Repair
    c. isolate it for further inspection
    d. keep it in service

26. Which defect in the canopy would most likely require a minor repair?
    a. Floats
    b. Picks
    c. Slugs
    d. Thread separations

27. To dry a washed parachute canopy you would
    a. wring the water out by hand
    b. wring with a mechanical wringer
    c. hang it in the sun
    d. hang it in the shade

28. Which is used to remove blood stains?
    a. Cold water
    b. Warm water
    c. Hot water
    d. Dry-cleaning solvent

CHAPTER 10

STITCHES, SEAMS, AND STITCHING

The Federal Standard Stock Catalog, DDD–S–751, Section IV (Part 5) is the official standard specification for stitches, seams, and stitching used in United States Government work. The information which follows is taken from this specification. Parachute blueprints and specifications reference the different type seams and stitchings wherever they are to be applied.

TERMINOLOGY

As a prerequisite to an understanding of seams and stitching used in the fabrication of garments and sewed articles, a clear understanding of the terms employed is essential.

A STITCH is the UNIT of THREAD FORMATION in the production of seams and stitching.

A SEAM consists of a series of stitches JOINING TWO or MORE PLIES of MATERIAL or MATERIALS.

STITCHING consists of a series of stitches embodied in a material for ORNAMENTAL PURPOSES or for FINISHING AN EDGE or for both.

A seam is used for joining or assembling materials in the production of an article; whereas, stitching is used for preparing parts for assembling, and includes ornamenting and finishing, such as clocking, crocheting, gimp stitching, panel stitching, serging, hemming, and similar operations.

STITCHES

The stitches in common use are classified, defined, and given a symbol for convenience in reference. There are many classes of stitches and within the classes there are various types of stitches. But, to the Parachute Rigger the class 300, type 301 lockstitch and the zigzag stitch, class 300, type 304, are the only two types used in the manufacture and maintenance of parachutes. The double zigzag stitch, a variation of the type 304, is a lockstitch and is applied in a zigzag pattern. The needle of the machine strikes first to the right of centerline; second, on the centerline; third, to the left of the centerline; and then it repeats itself in the other direction.

It must be understood that at the beginning of a stitch the ends of the threads are anchored. In referring to the passage of a thread or the loop of a thread through the material, such operations are made with uniform spacing between operations unless otherwise specified.

United States Stitch Type 301

This type of stitch is formed by two threads. A loop of one thread is passed through the material where it is entered by the mass supply of the other thread. The loop of the first thread then is drawn into the material to the extent that the interlocking of the threads is approximately halfway between the two surfaces of the material. These operations are repeated to form a sequence of stitches. The United States type stitch 301 is shown in figure 10–1.

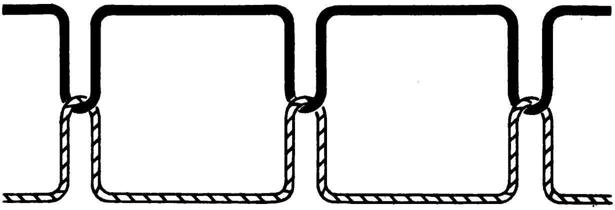


Figure 10–1.—United States stitch type 301.

The characteristics of any properly formed seam are strength, elasticity, durability, security, and appearance. The characteristics are discussed in the following paragraphs.

STRENGTH.—A seam should be of sufficient strength to withstand the strain to which it will be subjected in the use or wear of the articles of which it is a part. The elements affecting the strength of a seam are:

1. The type of stitch used.
2. The thread combination used.
3. The number of stitches per unit length of seam.
4. The tightness of the seam.
5. The construction of the seam.

ELASTICITY.—The elasticity desirable in a seam is determined by the elasticity of the material to be sewed. The elasticity of the seam should equal that of the material or materials joined. The elasticity of a seam produced of a properly formed, tightly drawn stitch, depends upon the type of stitch employed.

DURABILITY.—The durability of a seam depends largely upon its strength and the relation between the elasticity of the seam and the elasticity of the material. In the less elastic, tightly woven, and dense materials, there is a tendency for the plies to "work" or slide in each other. To form a durable seam in such materials, the stitch must be tight and the thread will set to the material to minimize abrasion and wear by contact with outside agencies.

SECURITY.—The security of a seam depends on the character of the seam, on the strength and durability of the thread used in forming the stitch, and on the type of stitch employed.

APPEARANCE.—The appearance of a seam is largely controlled by the seam construction. Under certain conditions it is essential that both sides of the seam appear the same; as, for instance, edge-stitching coats where the lapel is turned.

Each of these factors must be considered in determining the type of stitch to be employed in a seam for any given operation.

Seam Classification

Seams in general use are divided into classes. The seams in each class are subdivided into types. Each class and type is given a symbol for convenience in reference.

The symbol for each seam is divided into three parts. The first part denotes the class of seam and consists of two or more uppercase letters. For example, "SS." The second part denotes the type of the class and consists of one or more lowercase letters. For example, "a." The third part denotes the number of rows of stitches used and consists of one or more Arabic numerals preceded by a dash. For example, "–1." The complete symbol thus becomes "SSa–1."

Specification of a Seam

The specification of a seam shall include the seam symbol prefixed by the symbol of the stitch to be used therein; thus, a seam type SSa-1 formed with United States standard stitch type 301 shall be specified as "301–SSa–1."

In seams where more than one type of stitch is used, the symbol of the type of stitch nearest the edge of the material shall be placed first in the specification. Thus, a seam type SSa–2 formed with one row of stitch type 505 and one row of stitch type 101 shall be specified as "505–101–SSa–1."

Likewise, in the case of the specification of a 2-operation seam, the symbol of the stitch used in the first operation shall be placed first in the specification. Thus, seam type SSe–2 made by joining two plies together with stitch type 401 and then turning and stitching down with stitch type 301 shall be specified as "401–301–SSe–2." Where the same type of stitch is used for both operations, the symbol of the stitch type shall be repeated in the specification.

United States Standard Seam Class SS

The general characteristics of this class of seam is that the plies of material are superposed and joined with one or more rows of stitches. Following are seam construction illustrations of a number of typical examples of seams falling under the class SS.

The seam type SSa–1 is formed by superposing two or more plies of material and uniting them with one row of stitches. (See fig. 10–2.)

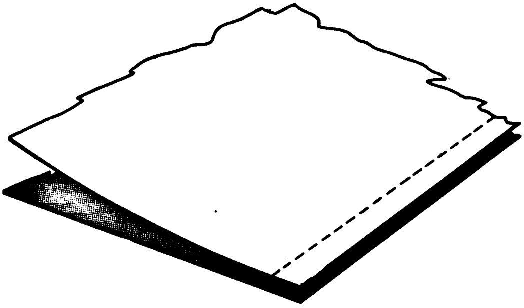


Figure 10–2.—Seam type SSa–1.

The SSc–2 type of seam is formed by turning the edge of both plies of the material to the inside and uniting with two rows of stitches. (See fig. 10–3.)

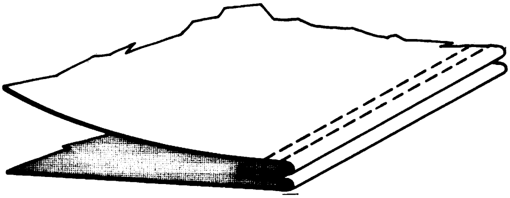


Figure 10–3.—Seam type SSc–2.

In making the SSe–2 type of seam, the plies of the material first are superposed and seamed as in forming seam type SSa–1. (See fig. 10–2.) The plies of the material are then turned and joined with one row of stitches, as shown in the seam construction drawing of figure 10–4.

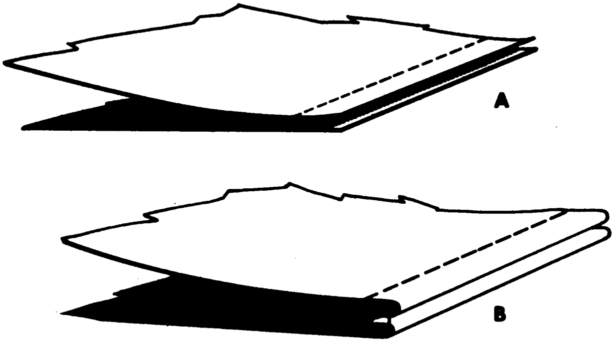


Figure 10–4.—Seam type SSe–2.

United States Standard Seam Class LS

In this class of seam the plies of material are overlapped a sufficient distance to hold the stitches and are joined with one or more rows of stitches.

The LSa–2 type of seam is formed by overlapping two or more plies of material and uniting them with two rows of stitches, as shown in the seam construction drawing of figure 10–5.

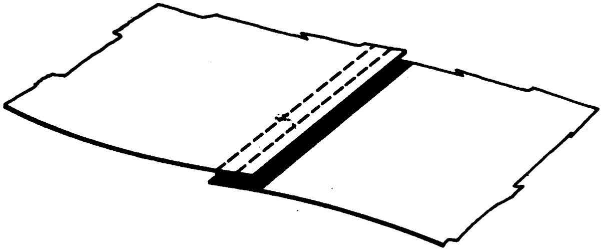


Figure 10–5.—Seam type LSa–2.

The LSb–2 type of seam is formed by turning the edge of one ply of the material and lapping it over another ply and uniting them with two rows of stitches, which also secures the turned-under portion of the one ply. The edge of the material on the outer surface will be concealed. (See fig. 10–6.)

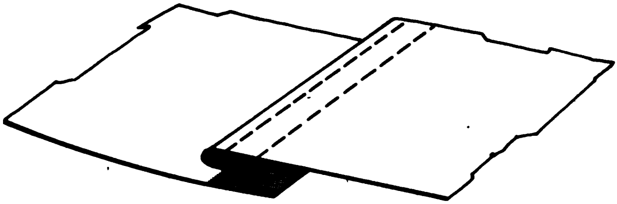


Figure 10–6.—Seam type LSb–2.

The LSc–2 type of seam is formed by turning the edges of both plies of material and lapping them, as shown in figure 10–7, and uniting them with two rows of stitches, which also shall secure the turned portions. The edges of the material are concealed.

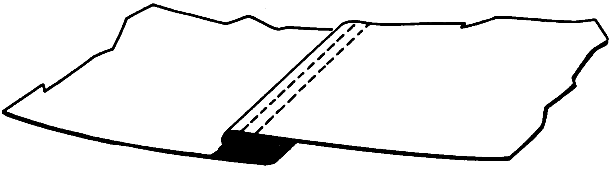


Figure 10–7.—Seam type LSc–2.

In making the LSs–2 type seam, the plies of material first shall be joined, as shown in (A) of figure 10–8. One ply then shall be turned back and the plies united with a second row of stitching, as shown in (B) of figure 10–8.

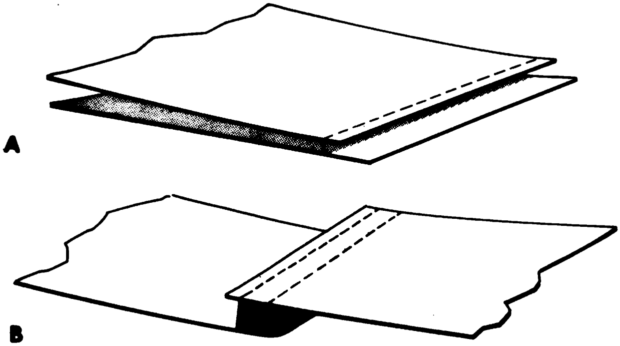


Figure 10–8.—Seam type LSs–2.

United States Standard Seam Class BS

This seam is formed by folding a binding strip over the edge of one or more plies of material and joining the plies and binding strips with a series of stitches.

The BSa–2 type of seam is formed by folding a binding strip over the edge of the ply or plies of body material and uniting the binding strip and body material with two rows of stitches. (See fig. 10–9.)

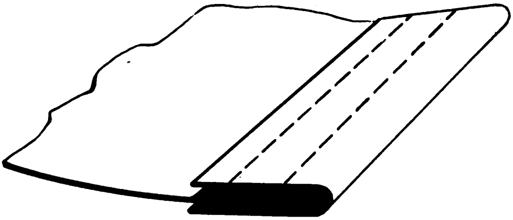


Figure 10–9.—Seam type BSa–2.

STITCHING

Stitching in general use is divided into classes and each class subdivided into types. Each class and type is given a symbol for convenience in reference.

The symbol for each kind of stitching is divided into three parts:

The FIRST PART denotes the CLASS OF STITCHING and consists of two or more uppercase letters; for example, "OS."

The SECOND PART denotes the TYPE OF THE CLASS and consists of one or more lowercase letters; for example, "a."

The THIRD PART denotes the NUMBERS OF ROWS OF STITCHES used and consists of one or more Arabic numerals preceded by a dash; for example "–1." The complete symbol thus becomes, for example, "OSa–1."

Specification of Stitching

The specification of stitching shall include the stitching symbol prefixed by the symbol of the stitch to be used therein; thus, for example, stitching type OSa–1, formed with United

States standard stitch type 101, shall be specified "101–OSa–1."

U. S. Standard Stitching Class OS

This class of stitching is a series of stitches embodied in a material either in a straight line, a curve, or following a design.

The OSa–1 type of stitching is produced with one row of stitches. (See fig. 10–10.)

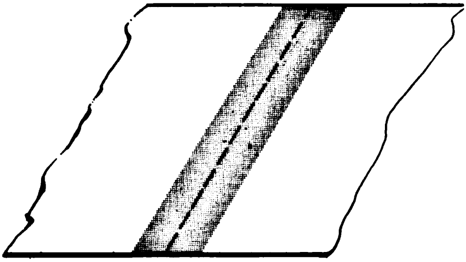


Figure 10–10.—Stitching type OSa–1.

The OSf–1 type of stitching is produced by folding and uniting the plies of the material near the fold. (See fig. 10–11.)

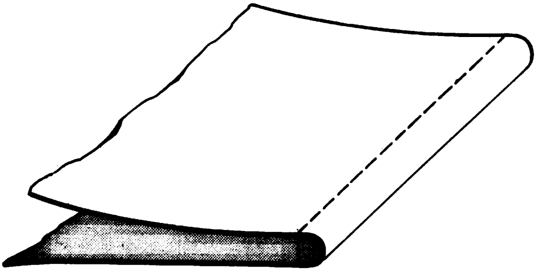


Figure 10–11.—Stitching type OSf–1.

United States Standard Stitching Class EF

This class of stitching consists of a series of stitches formed at or over the edge of a material, the edge being either folded or not folded, or that the edge of the material is folded and joined to the body of the material with a series of stitches.

The EFb–1 type of stitching is produced by turning the edge of the material, folding it back over the body of the

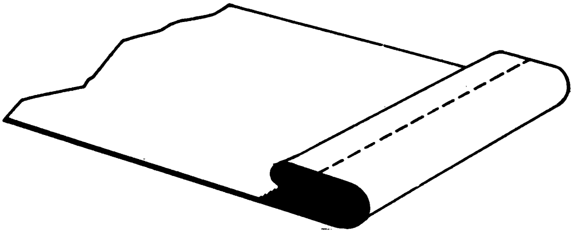


Figure 10–12.—Stitching type EFb–1.

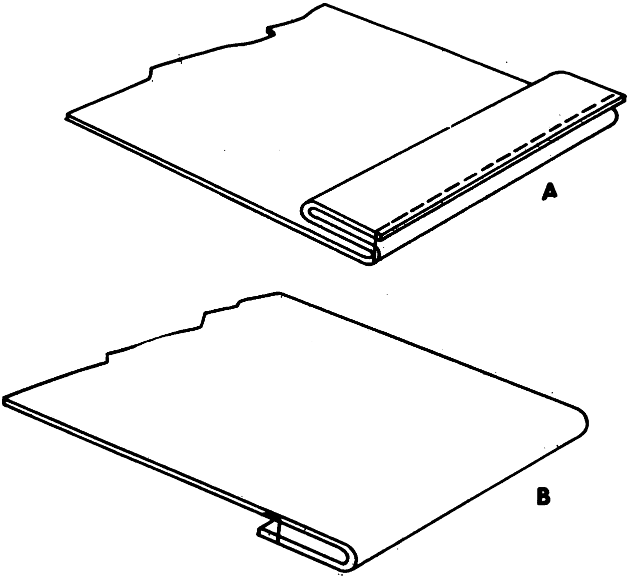


Figure 10–13.—Stitching type EFc–1.

material, and uniting the portion so turned and folded to the body of the material with one row of stitches. (See fig. 10–12.)

The EFc–1 type of stitching is produced by turning the edge of the material, as shown in (A) of figure 10–13, and uniting the portion so turned to the body of the material with one row of stitches. In sewing, the material is so guided that the needle only partially penetrates the folded edge. When the material is laid flat, the stitches do not show on the outer face of the material. (See (B) of fig. 10–13.)

QUIZ

1. A seam consists of a series of stitches
    a. embodied in a material
    b. joining two or more plies of material
    c. formed with a needle thread only
    d. placed in two parallel rows
2. Stitching consists of a series of stitches
    a. embodied in a material
    b. joining two or more plies of material
    c. formed with a needle thread only
    d. placed in two parallel rows
3. Two types of stitching are employed in the manufacture of parachutes. They are a
    a. lockstitch and chain stitch
    b. lockstitch and zigzag stitch
    c. chain stitch and zigzag stitch
    d. chain stitch and blind stitch
4. Class 300, type 301, denotes a
    a. blind stitch
    b. chain stitch
    c. zigzag stitch
    d. lockstitch

5. The symbol for each seam is divided into
   a. one part
   b. two parts
   c. three parts
   d. four parts

6. In the designation LSc–2, the letters LS indicate that it is a
   a. lap seam
   b. lockstitch
   c. loop stitch
   d. seam, but does not indicate what type it is

7. In the designation SSa–2, the number 2 means that
   a. there are two threads used in the stitch formation
   b. there are two rows of stitches used
   c. the seam is formed from two plies of fabric
   d. two steps are required to construct the seam

8. Of the following designations for a seam employing a lockstitch and being of superposed construction, only one is correct. It is
   a. U. S. std. 304–SSa–1
   b. U. S. std. 304–LSc–2
   c. AN std. 301–SSc–1
   d. U. S. std. 301–SSc–2

9. The designation 505–301–SSa–2 means that
   a. two seams are to be formed, one employing type 301 stitch and one a type 505 stitch
   b. one row of stitches is to be formed with type 301 stitches and one row with type 505 stitches
   c. the row of stitches nearest the edge of the fabric is formed with type 301 stitches
   d. the inside row of stitches is formed of type 505 stitches

10. LSc–2 seam employs
    a. one row of stitches
    b. two rows of stitches
    c. three rows of stitches
    d. four rows of stitches

11. The Federal Standard Stock Catalog, Section IV (Part 5) is the official standard specification for
    a. stitches, seams, and stitching
    b. stitches only
    c. seams only
    d. stitching only

12. What stitching must be used to make a hem when the material is laid flat and the stitches do not show on the outer face of the material?

a. OSa–1
b. OSf–1
c. EFb–1
d. EFc–1

13. A piece of fabric is folded and a row of stitches is placed near to, and parallel with the folded edge. This type of stitching would be classified as

a. OSa–1
b. OSf–1
c. EFb–1
d. EFc–1

14. When a binding strip is stitched over the edge of a material, what type of seam is required?

a. SSa–1
b. BSa–2
c. LSc–2
d. LSs–2

15. If the edges of the seam remain exposed after the seam has been constructed, it is an

a. LSb–2
b. SSc–2
c. EFb–1
d. SSa–1

APPENDIX I

GLOSSARY

Adapter.—A metal buckle-like part used in conjunction with parachute harness and webbing straps primarily as an anchoring point. It has little value as an adjusting device since the advent of quick adjustable hardware.

Adapter, quick fit.—Hardware used in conjunction with harness chest straps. This adapter is designed with a sliding, locking bar for adjustment purposes.

Apex.—Highest point; top of the canopy.

Arm, sewing machine.—The sewing machine arm (molded metal section of the head) houses the arm shaft and supports the face-plate housing at the opposite end from the uprise together with its internal parts. The arm is suspended from the top of the uprise horizontally above the bed of the machine.

Assembly, canopy and lift web.—Designation indicates reference to the quick attachable chest type parachute and only concerns the canopy and lift web assembly.

Assembly, harness and cushion.—Designation indicates reference to the quick attachable type parachute. Harness and cushion assembly is separate from the chest unit.

Assembly, lift web.—Small and separate risers designed as a unit to be carried by the parachute pack. The suspension lines are attached on one end, and hardware snaps on the other end. The snaps provide attachment of this assembly to the quick attachable harness.

Assembly, pack.—An enclosure for the parachute canopy, pilot chute, and suspension lines. Design of the pack varies with the type of parachute.

Assembly, parachute.—Assembly designates the ENTIRE parachute which includes the harness and all appendages.

Assembly, pilot chute spring.—Spring used to actuate the pilot chute.

Assembly, pilot parachute.—Small auxiliary parachute secured to the peak of the main canopy designed to hasten the opening of the main canopy.

Assembly, ripcord.—Releasing device used to operate the parachute. Ripcords are designed in varying lengths and handgrips. The length of the ripcord and shape of the grip depends on the type of parachute.

ASSEMBLY, RIPCORD HOUSING.—Ripcord passes through the housing which guides and protects the ripcord cable.

BAG, CHAFING.—A parachute bag, sometimes called a traveling bag.

BAG, EMERY.—A small round-shaped bag filled with emery dust or other fine abrasive powder used to sharpen the blunt end of needles or to remove rough or rust spots.

BALL, CABLE RETAINING.—This ball is used in the manufacture of ripcords and is used to secure the grip to the ripcord cable.

BAND, PACK OPENING.—Coil springs arranged in parallel and cloth covered. Hooks join the series at each end. Bands are fastened to the pack and draw back the sides and ends of the pack after the ripcord has been pulled. Each opening band is a complete and separate assembly.

BAR, SPREADER.—Flat metal hooks used to retain the parachute under tension during part of the packing process.

BODKIN.—A flat, blunt-end, large-eye needle used for inserting tape, tie cords, and the like, into casings or channels.

BOTTOM, DOUBLE.—A false bottom; a second bottom panel in the pack.

BOTTOM, FALSE.—The inner bottom piece of the parachute pack carrying the hesitator loops.

CANOPY, CONICAL.—The peak of the 26-foot 22-gore canopy is more cone-shaped than older service type canopies, and when inflated may easily be identified by its raised portion at the top.

CANOPY, 28-FOOT, RIPSTOP, NYLON ASSEMBLY.—Used on all service parachutes as the main body or sail of the parachute, capable of resisting the air and providing a safe rate of descent for an individual of average weight.

CANVAS.—A heavy, closely woven cloth of hemp or flax, used for tents, sails, covers, and the like; also a similar cloth of tow, jute, or cotton.

CHUTE, ANTISPIN.—A small parachute used in certain aircraft to correct or prevent a spinning motion.

CHUTE, BRAKE.—A ribbon-type parachute used to reduce the aircraft's speed after landing.

CHUTE, CARGO.—A parachute used for dropping supplies and equipment, an Air Force specialty.

CLOTH.—A pliable fabric, woven, felted, or knitted from any filament; commonly fabric of woven cotton, woolen, silk, nylon, rayon, or linen fiber.

CLUB, CATERPILLAR.—Anyone making an emergency parachute descent is eligible for membership in this club sponsored by parachute manufacturers.

CONE, LOCKING.—Small, metal, conical piece of hardware sewed to pack, forms part of releasing device. Used in conjunction with side flap grommets and ripcord pins. This device holds the pack closed and also permits a safe and smooth opening when the ripcord pins are released.

CONSTRUCTION, BIAS.—The warp of the material is placed at a 45° angle to the centerline of the gore of the canopy instead of running straight up and down, parallel to the centerline. This type of construction offers a great amount of resiliency which is an important characteristic to the parachute.

CONSTRUCTION, STRAIGHT.—Cloth cut and sewed parallel to the warp and filler (woof) threads of the weave.

CUSHION, BACK ASSEMBLY.—A thin, cloth-covered, sponge-rubber pad attached to the harness to provide comfort.

CUSHION, SEAT ASSEMBLY.—A square cloth-covered cushion, equipped with a slot to provide passage for the harness leg straps.

DECELERATE.—To slow down. A free-falling body will decrease its rate of descent due to pressure of the atmosphere against its frontal area. This resistance will gradually increase as the falling body nears the earth due to increasing atmospheric pressure.

DENIER.—A unit of measurement of silk in which the size of yarn is quoted as its weight per length. This is determined by weighing 9,000 meters and quoting the size of the yarn in grams. Thus, if 9,000 meters weigh 30 grams, the size of the yarn is then known as 30 denier.

DIAMETER, PROJECTED.—The inflated diameter of the parachute. The inflated diameter is less than the flat diameter.

DUCK.—A linen or cotton fabric, finer and lighter than canvas, but similar to it.

DUMMY, PERSONNEL PARACHUTE.—A weight used for testing parachutes. The weight of a dummy varies from 150 to 400 pounds depending on the types of tests to be conducted. Torso-shaped dummies are used when the harness is being tested.

EXTENSION, PEAK.—A length of webbing fitted with a hook on one end. Several grommets, equally spaced throughout the unit's length, provide for fastening the peak of the canopy under tension during part of the packing process.

EYE.—Wire anchoring device designed to receive hooks. "Hooks and eyes."

FASTENER, PACK TAB (OVAL).—Metal device located on both ends of parachute pack. End tabs are passed over locking cones to hold ends of pack closed.

Fastener, slide.—A zipper.

Fastener, snap.—Metal fastening device usually consists of four parts: button, socket, stud, and eyelet. Device is manufactured in various shapes and sizes. (*See* ch. 8.)

Ferrule.—Device which provides a strong and smooth finish on the ends of a ripcord housing.

Fitting, swaged.—A fitting attached to an object by a pressure process involving special tools and dies.

Frame, pack.—Metal wire frame used to give chest and seat type parachute packs shape and rigidity.

Frame, pilot chute, USAF 046209.—Spider legged wire frame equipped with two springs to operate pilot chute.

Gore.—That portion of the 28-foot canopy contained between two adjacent radial seams. This area is triangular and consists of four sections or panels and is bordered by two radial seams, a skirt at periphery edge, and a vent collar at the peak.

Grip, ripcord assembly.—Handle secured to ripcord cable and held in a pocket usually located on the harness. A "pull" on the grip will operate the parachute. The grip is often referred to as the "hand pull."

Grommet and washer.—Metal device used to reinforce holes in fabrics. The shank of the grommet passes through a hole in the washer and is crimped over it in the setting process.

Harness.—The webbing assembly securing the wearer to his parachute and worn on the body encompassing the shoulders, back, chest, hips, and groin.

Harris, Lt. H. R.—Harris made the first emergency parachute descent with a free-type parachute at McCook Field on October 20, 1922.

Head, sewing machine.—The head is the entire metal housing which supports the moving parts and bearings of the machine.

Heinecke.—A German designed parachute; it was the first to save the life of an airplane pilot in combat in 1918.

Hem.—A hem merely serves as a means of finishing an edge.

Index, parachute.—List of parts and part numbers required to manufacture each type of parachute. Indexes are furnished by the Naval Aircraft Factory.

Keeper, bridge.—Device used in closing the lock chain parachute pack.

Keepers.—Fabric guides used to hold various appendages of the parachute in place.

Knee lifter, sewing machine.—The knee-lifting mechanism operates the presser foot and/or pressers, up and down through a series of linkages starting from the underside of the machine table.

Knot, surgeon's.—A square knot executed with two turns instead of one in the first step of tying the knot. The extra turn temporarily provides additional holding power so the hands are free to accomplish the second step.

Line over.—A type of simple foul occurring during the opening of the parachute. One or more suspension lines partially passed over the top of the canopy reduces the projected diameter and can have a serious effect on the rate of descent.

Line, static.—A length of webbing or similar strong purchase secured to the releasing device and to a structural part of the aircraft for dropping cargo and paratroop personnel.

Lines, suspension.—Network of nylon braided lines which connects the canopy to the harness. The number of suspension lines varies with the diameter of the parachute. (Sometimes caled SHROUD LINES.)

Link, removable connector.—Hardware used to secure the suspension lines to the risers of the harness or lift web assembly of a quick attachable parachute.

Link, triangle.—Hardware used in conjunction with a snap to secure the harness.

Load, proof.—The testing of an item for conformance with strength requirements.

Load, shock.—The maximum load or stress to which the parachute and its components are subjected during the second stage of inflation of the canopy.

Lockstitch.—Type of stitching used in manufacturing parachutes. This type of stitch is formed by two threads. A loop of one thread is passed through the material where it is entered by the supply of the other thread. The loop of the first thread is drawn into the material to the extent that the loop or lock is approximately halfway between the two surfaces of the material. This is a type 301 stitch.

Loop, pilot chute.—Loop formed at the bottom of the pilot chute suspension lines used to secure it to the main canopy.

Loops, hesitator.—Retain the suspension lines in a neat and orderly arrangement in the parachute pack. These loops are made in varying sizes and materials.

Material, bolt of.—A compact package or roll of cloth, usually about 40 yards.

Mercerized.—The treatment of cotton fiber or fabrics with a solution of caustic alkali to make the fiber stronger and more receptive to dyes, often in a way to give a silky luster.

Motor, electric, 3-phase.—A 3-phase electric motor requires relatively little maintenance, due to its design and construction characteristics. It is more adaptable for use on industrial type sewing machines. Maintenance problems, other than simple lubrication, are the responsibility of an electrician.

Needles.—There are three common types of needles used for general hand sewing: sharps, betweens, and crewels.

Nylon.—A synthetic material of protein-like structure derived from coal, air, and water, which is adapted for fashioning into filaments of extreme toughness, strength, and elasticity, and used in the manufacture of parachutes.

Nylon, ripstop.—A type of weave designed to prevent tears from spreading. Extra numbers of yarns are closely woven into the cloth intermittently across the width and across the length.

Nylon, tubular.—Sleeve-like weave, seamless, and pressed flat, similar in appearance to tape, but stronger and hollow in the center.

Oscillations, parachute.--A pendulum-like action of an inflated canopy during descent.

Panel.—Same as a section of a gore.

Parachute, flat-type.—Reference is directed to the type of canopy construction which will lie perfectly flat when stretched out. A formed type canopy will not lie flat.

Parachute, manually-operated.—A parachute operated by the wearer. The ripcord must be pulled by hand to release the parachute after the jumper is in the air and free from the aircraft.

Parachute, static line operated.—A parachute operated by a length of webbing after the jumper has fallen the length of the static line. The ripcord pins are pulled from the pack, the parachute opens, and a "break tie" breaks, freeing the parachute.

Paraffin.—An inflammable, waxy substance produced by distilling wood, shale, coal, etc., and also occurring in the earth as a constituent of petroleum or as a solid deposit.

Parts list, sewing machine manufacturer's.—The proper nomenclature for every part of a particular sewing machine can be found in the manufacturer's List of Parts.

Permeability, air.—A measure of the rate of flow of air through fabric, denoted in cubic feet of air which will pass through a square foot of fabric in one minute under a certain pressure drop.

Pin, locking.—This part is used in the manufacture of ripcords by swaging methods and is used to hold the parachute in a closed position. A "pull" on the ripcord will cause the pins to be withdrawn from the locking cones.

Pleats, accordion.—Multiple folds of cloth placed one upon the other.

Pocket, log record.—Parachute pack pocket used to hold packing data card and signal code. Each pack contains two pockets, one is sewed to the inside of the pack and the other is located on the outside.

Pocket, ripcord handle.—Elastic or spring edged pocket holds ripcord handle in an accessible position on the harness. The chest type pocket consists of a piece of straight elastic webbing serving the same purpose.

Polygon.—A figure generally plane and closed, having many angles and hence many sides; one having more than four sides.

Porosity.—The state or quality of the fabric being porous. This is controlled by the weave of the fabric which determines the permeability of the cloth by the measurement of an airflow.

Pull, cloverleaf hand.—Resembling a cloverleaf. This shape grip is used on all chest type parachutes and on some training back type parachutes.

Release, barometric pressure.—A spring wound device for automatically opening a free-fall type parachute, operating on the differences of barometric pressure in conjunction with a timing element.

Release, quick.—A device for releasing the canopy from the rest of the parachute.

Ring, D.—Metal D-shaped hardware used in conjunction with parachute harness, provides attachment points for chest type parachute.

Ring, pull.—See ripcord assembly grip.

Ring, V.—Used in conjunction with snaps to fasten the harness around the wearer. Same use as the newer triangle link but different in shape.

Ring, vent.—A molded elastic ring, enclosed in the hem of the vent collar. This holds the vent partially closed and free to expand with varying pressures (28-foot canopy).

Risers.—Lift webs, or that webbing section of the harness coming in contact with the removable connector links which join the canopy to the harness. A lift web assembly is a separate assembly, and is not to be confused with the "fixed" reference given this part for the seat and back type parachutes. The chest type parachute carries a lift web assembly as a complete unit.

Sail.—Main body of cloth of pilot chute and parachute canopy.

Seams.—Seams join two pieces of fabric together.

Seams, diagonal.—Lateral or cross seams joining the sections or panels of a gore and cut at an angle of 45° to the centerline of each gore.

Seams, radial.—Seams radiating from vent to skirt, joining gores. These form channels for the suspension lines on 28-foot canopies.

Sewing machine 111 W 150.—A high-speed, single needle, lockstitch, compound feed machine employing a belt driven rotary hook with a vertical axis. The machine has ball bearings on the upper and lower shafts and in the hook saddle. It is designed for stitching medium fabrics and is used in the manufacture and repair of parachutes, clothing, and numerous other articles. It is driven by a ⅓-hp. motor which operates on a 60-cycle, 3-phase current at 1,725 r. p. m. It has an arm clearance of 10½ inches and a bed length of 18¾ inches. A complete unit consists of a machine head, a table, and a stand.

Sewing machine 111 W 155.—A single needle, lockstitch, compound feed machine with a vertical-axis rotary type sewing hook, and alternating pressers having ½-inch lift. It has a safety clutch which prevents the hook from being damaged or getting out of time due to accidental strain. The maximum stitch length is 3½ to the inch and it has an adjustable lifting eccentric to instantly set the alternating pressers to the minimum amount of lift required for the work to be sewed. This machine is not adaptable for sewing very lightweight fabrics such as bunting, fluorescent cloth, and nylon. It is driven by a ⅓-hp. motor which operates on a 60-cycle, 3-phase current at 1,725 r. p. m. It has an arm clearance of 10½ inches and a bed length of 18¾ inches. A complete unit consists of a machine head, a table, and a stand.

Sewing machine 31–15.—A single needle, lockstitch, drop feed machine with a horizontal-axis sewing hook operated in an oscillating motion. The machine is intended for stitching lightweight fabrics such as bunting, fluorescent cloth, and nylon. It is driven by the same motor as the 111 W 150, has an arm clearance of 10¼ inches, and a bed length of 18¾ inches. A complete units consists of a machine head, a table, and a stand.

Sewing machine 7–31.—A single needle, lockstitch machine with oscillating type sewing hook designed for sewing heavy canvas and other similar work. It is equipped with alternating pressers and has a clearance of 9/16 inch under the presser feet. Stitch regulation provides for stitches ranging in length from 2 to 8 to the inch. It is driven by a ½-hp. motor which operates on a 220-volt, 60-cycle, 3-phase current at 1,725 r. p. m. It has an arm clearance of 15⅞ inches and a bed length of 25¼ inches. A complete unit consists of a machine head, a table, and a stand.

Shears, pinking.—Used for finishing seams after stitching. Shears make a zigzag cut which prevents fraying.

Size.—Any of various glutinous materials, as preparations of glue or flour, used for filling the pores in the surface of paper, fiber, plaster, cloth, etc., or in bookbinding for applying color, gold leaf, or the like to book covers.

SKEIN.—A quantity of yarn, thread, silk, etc., put up after it is taken from the reel in a loose twisted loop.

SNAP.—Hardware used in conjunction with the triangle link to secure the harness. This snap has no sliding bar and is used in the chest strap.

SNAP, QUICK CONNECTOR.—Hardware used in conjunction with the "D" ring for attaching the chest type parachute pack to the harness.

SNAP, QUICK FIT.—Hardware used in conjunction with the triangle link to secure the harness. This snap is designed with a sliding bar for adjustment and is used in the leg straps.

STIFFENER, PACK.—Flat piece of fibrous material used to stiffen cloth flaps.

STITCH, ZIGZAG.—A lockstitch; the stitches being zigzagged across the centerline of stitches. The double zigzag stitch strikes in the centerline as well as on either side of it.

STRAP, CROSS-CONNECTOR.—A "safety strap"; a short length of webbing sewed across a lift web assembly. This webbing is designed to prevent a "streamer" if only one side of the lift web assembly is engaged in the harness.

STRENGTH, TENSILE.—The greatest longitudinal stress a substance can bear without tearing.

TABLE, SEWING MACHINE.—The table acts as the stand for the head of the machine and the other parts which make up the entire assembly.

TACKING, BUTTERFLY.—Break tacking used to secure lift web assembly in chest type parachute pack.

TAPE.—A narrow woven ribbon of cotton, linen, or nylon.

TEST, BURST.—A method of testing material by applying pressure on the flat surface of fabrics until they actually burst.

TEST, DROP.—Testing a parachute by dropping it attached to a torso-shaped dummy.

THREAD.—A thin, continuous filament. One made by spinning the fibers of cotton, flax, silk, etc., and combining the strands so produced. Nylon thread is very elastic and is used exclusively on the nylon materials of the parachute.

THREAD, "S" TWIST.—If spirals of twists incline downward in a right-hand direction, thread has an "S" twist. Opposite of "Z" twist.

THREAD, "Z" TWIST.—If spirals of twists incline downward in a left hand direction, thread has a "Z" twist. Opposite of "S" twist.

TIE, BREAK.—Any tie or tacking designed to break under a specified amount of stress.

TRANSMITTER, ELECTRIC (SINGER).—The electric transmitter consists of a motor, flywheel, and clutch arrangement, which, when secured to the table and stand of a Singer Sewing Machine will provide the necessary smooth power for operation.

Trapezoidal.—A plane four-sided figure with two parallel sides. A trapezoid handgrip is used on seat and back type parachutes.

Unit, chest parachute.—Refers to the chest pack, canopy, lift web assembly and all appendages connected with the pack. This does not include the harness.

Uprise, sewing machine.—The uprise is the upright part of the head (generally located on the right side of the head) that houses a portion of the moving parts that transmit motion through mechanical shafts and linkages to the mechanisms in the base of the machine.

Velocity, terminal, of a free-falling body.—The greatest speed at which a body falls through the atmosphere (14.7 p. s. i.). Resistance of the air overcoming the pull of gravity establishes the approximate figure of 176 feet per second or 120 m. p. h.

Wax.—A substance secreted by bees for constructing the honeycomb; beeswax. It is a dull-yellow solid of agreeable odor, plastic when warm, and melting at about 143°–151° F.

Weave.—The forming of a textile by interlacing yarns. The making or manufacturing of cloth on a loom by interlacing warp and filling yarns. The methods or patterns of weaving are plain or taffeta weave, in which the threads interlace alternately; basket weave, in which double threads are interlaced as in plain weave; satin weave, in which warp threads interlace with filling threads at points distributed over the surface, thereby producing a smooth-faced fabric; and twill weave, in which the filling threads pass over one and under two or more warp threads, thereby giving an appearance of diagonal lines, or ribs.

Webbing.—A stout, close-woven tape used for straps, belts, harnesses, etc.

Webbing, pilot chute tie.—Webbing used to tie the pilot chute to the main canopy.

APPENDIX II

TENSILE STRENGTHS

The tensile strengths of the materials used in the manufacture of parachutes are listed in the specifications. Specifications detail the physical quality of any product, depending on its use and purpose. All materials used in making a parachute are manufactured to the highest standards of workmanship. No one has the authority to change a single item in the manufacturing process without the permission of the specifying agency. The parachute is therefore manufactured in strict accordance with dozens of specifications and drawings, and must be so maintained throughout its service life, if it is to perform properly.

The purpose of this section is to present a picture to show the strength of the materials that are incorporated in the parachute. The Parachute Rigger should be so impressed with these figures that he will not tolerate the use of substandard material in his repairs. A knowledge of tensile strengths better equips the Parachute Rigger to design local projects which must meet tensile strength requirements.

Nylon Thread

REFERENCE.—MIL–T–7807, 20 November 1951.

USE.—High tenacity nylon thread and cord used in parachute manufacture.

COLOR.—White and olive drab.

CLASSIFICATION.—Types I and II are used in the manufacture of parachutes. Type I is a MACHINE TWIST thread. Type II is a TWISTED BONDED MULTICORD thread. Class 1 is used in the manufacture of parachutes. Class 1 is a low-stretch thread, maximum elongation 22 percent.

Physical Requirements

Type	Size	Class	Average breaking strength (pounds, minimum)
	Thread:		
I	A	1	2.75
II	B	1	5.50
II	E	1	8.50
II	FF	1	16.00
	Cord:		
I	No. 3	1	24.00
II	No. 6	1	50.00

Nylon Cord

REFERENCE.—MIL–C–5040A (ASG), 15 July 1953.

USE.—Nylon cord for use as suspension lines for parachutes.

COLOR.—Unless otherwise specified the color will be natural.

CLASSIFICATION.—Type I cord, 100 pounds breaking strength. Type III cord, 550 pounds breaking strength.

Physical Requirements

Type	Breaking strength (pounds, minimum)
I	100
III	550

Nylon Reinforcing Tape

REFERENCE.—MIL–T–5038–2, 12 September 1951.

USE.—Parachute container or pack reinforcements, edging, hesitator loops, and retainers, general strengthening of stress-areas.

COLOR.—Olive drab, in accordance with specifications of the color code and ANA Bulletin No. 157.

WEAVE.—Many tapes can be identified by observing the patterns of their weaves. Type II tape is a plain weave. Type IV tape is composed of two ground warps. Type VI tape is a herringbone style which differs only slightly from type IV.

Physical Requirements

Type	Width (inches)	Tensile strength (pounds per inch, minimum)
III	¾	400
IV	1	1, 000
IV	1½	1, 500
VI	¾	425

Soft Textile Nylon Webbing

Reference.—NAF Specification W–54, 20 January 1953.
Use.—Parachute harness.
Color.—Olive drab.
Figure II–1 illustrates the weave.

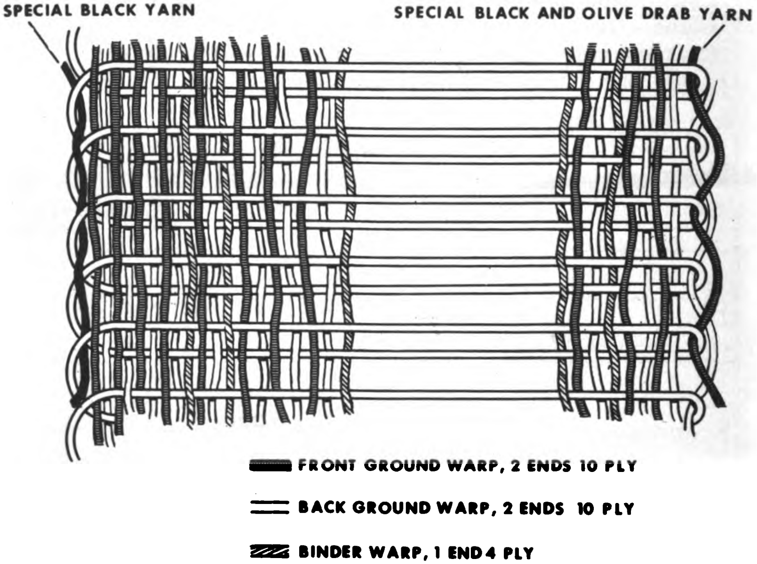

SPECIAL BLACK YARN
SPECIAL BLACK AND OLIVE DRAB YARN
FRONT GROUND WARP, 2 ENDS 10 PLY
BACK GROUND WARP, 2 ENDS 10 PLY
BINDER WARP, 1 END 4 PLY

Figure II–1.—Webbing construction.

Physical Requirements

Width (inches)	Breaking strength (pounds, minimum)
$1\frac{23}{32} \pm \frac{1}{16}$	6,000

NOTE: Specification MIL-W-4088B (USAF) of 6 January 1953 lists 6,000-pound webbing as Type XVIII. The material used is TEXTILE WOVEN NYLON, and the weave specifications are almost identical with NAF Specification W-54.

Nylon Tubular Webbing

REFERENCES.—MIL-W-4088B (USAF), 6 January 1953.
MIL-W-6134, 8 May 1950.
MIL-W-5625, 16 February 1953.

USE.—Parachute canopy.

COLOR.—Natural.

Physical Requirements

Type	Width (inches)	Location	Breaking strength (pounds, minimum)
1 (condition "U")*	$\frac{9}{16}$	Suspension line reinforcement.	500
Woven nylon tubular webbing, aircraft quality.	1	Vent reinforcement.	3, 000
Nylon warp, cotton filling.	1	Skirt hem	525
Woven nylon tubular webbing, aircraft quality.	$\frac{1}{2}$	Pilot chute connector cord.	1, 000

*Condition "U" signifies an UNTREATED webbing. Some webbing is treated to increase its ability to withstand abrasion.

Nylon Parachute Cloth

Reference.—MIL–C–7020B(ASG) 29 September 1953.

Use.—Parachute canopy gores and panels.

Color.—Natural, unless otherwise specified.

Physical Properties of Type I Cloth

Weight, ounces per square yard (maximum)	1.1
Breaking strength, pounds per inch of width (minimum):	
Warp	40
Filling	40
Tear resistance, pounds (minimum):	
Warp	3.5
Filling	3.5
Air permeability, cubic feet per minute per square foot of cloth	80–120

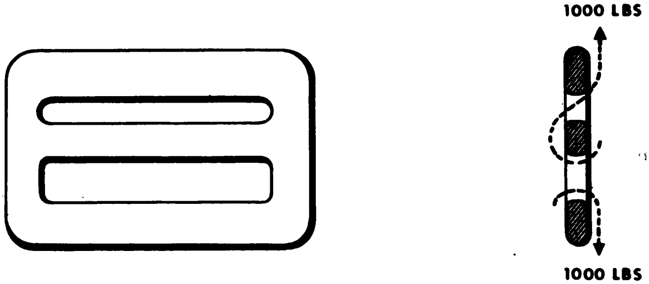
Harness Hardware

Reference.—MIL–H–7195, 10 May 1951.

Use.—Parachute Harnesses.

Study figures II–2 through II–12 for tensile strength requirements.

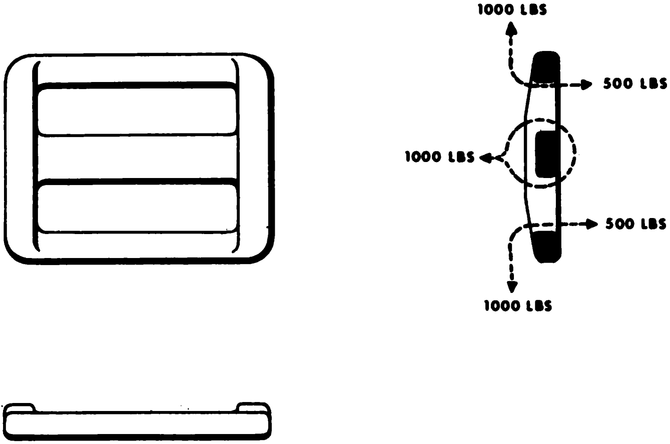
The ultimate strength is assumed to be a minimum of 1½ times the proof-load as is customary for aeronautical equipment.



ADAPTER-PARACHUTE HARNESS STRAP

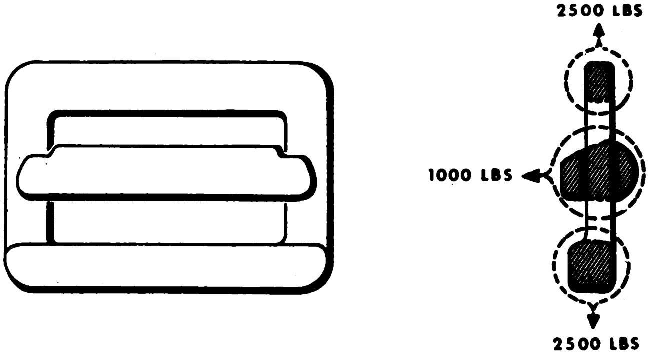
AN 6565-1A

Figure II–2.



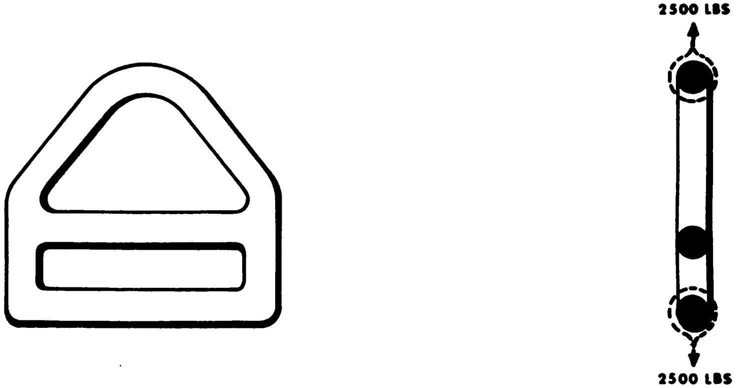
ADAPTER-PARACHUTE HARNESS STRAP
STYLE (B)
AN 6566

Figure II—3.



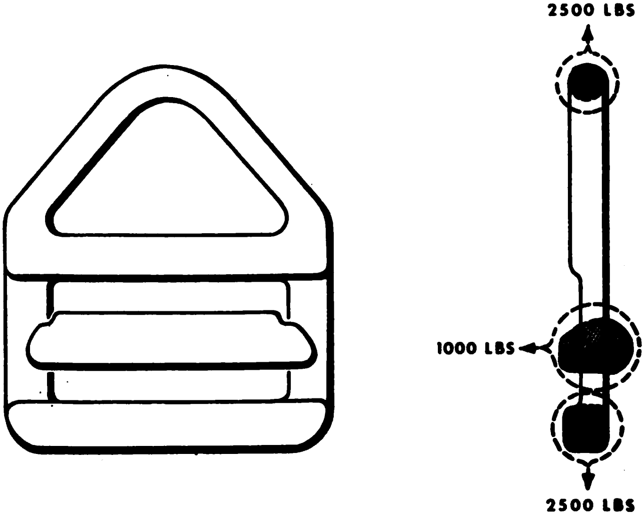
ADAPTER-PARACHUTE HARNESS QUICK FIT
AN 6517

Figure II—4.



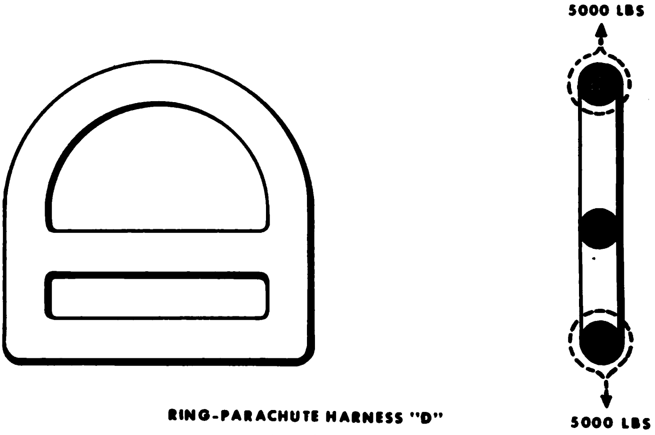
RING-PARACHUTE HARNESS "V"
AN 6563

Figure II–5.



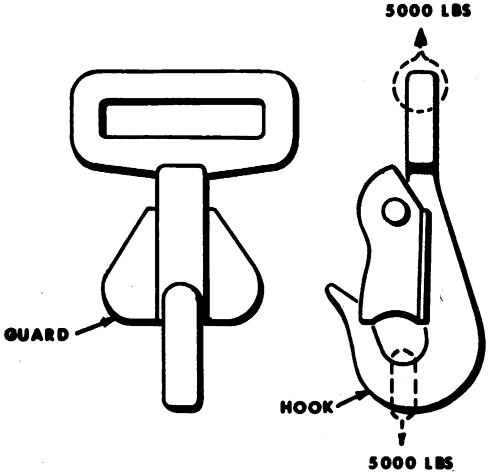
RING-PARACHUTE HARNESS QUICK FIT "V"
AN 6508

Figure II–6.



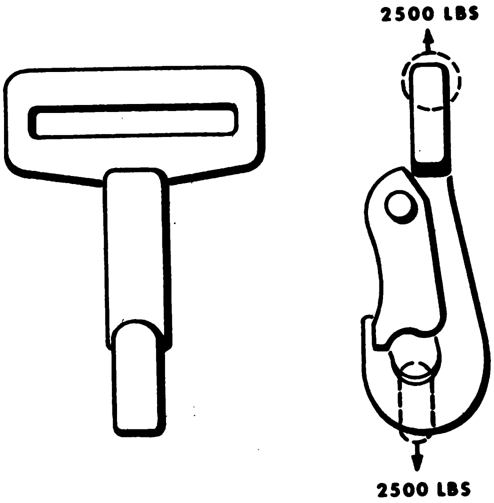
RING-PARACHUTE HARNESS "D"
AN 6564

Figure II–7.

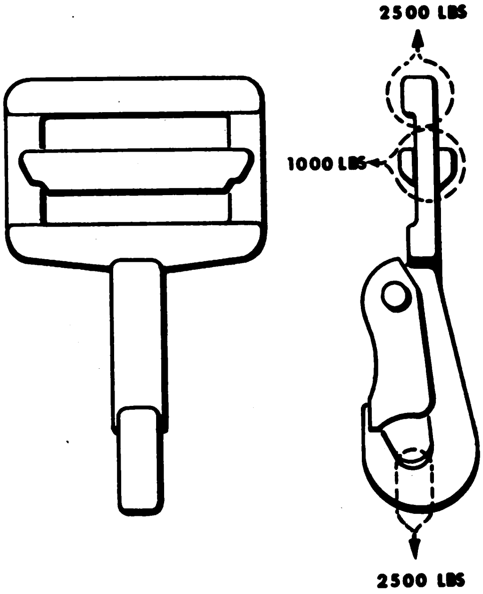


SNAP-QUICK CONNECTOR PARACHUTE HARNESS
AN 6507

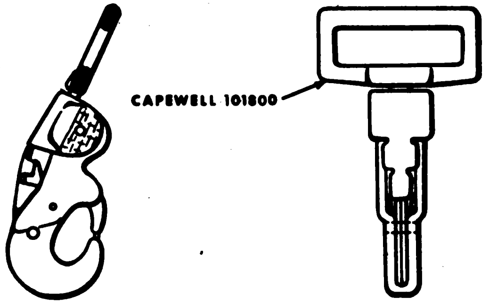
Figure II–8.



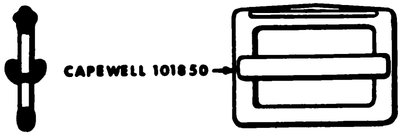
SNAP-COILED SPRING TYPE PARACHUTE
AN 6516
Figure II—9.



SNAP-PARACHUTE HARNESS QUICK FIT
AN 6509
Figure II—10.

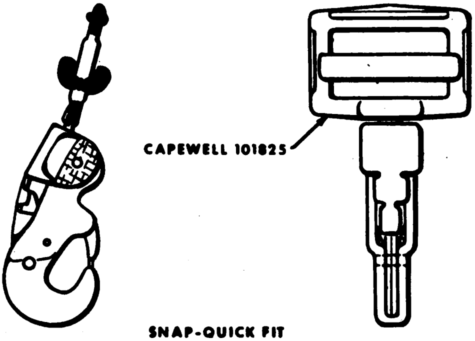


SNAP

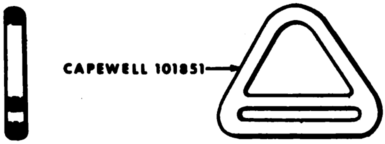


ADAPTER-QUICK FIT

Figure II-11.



SNAP-QUICK FIT



LINK-TRIANGLE

Figure II-12.

Miscellaneous

Ripcord assembly.—To be proof-loaded to withstand a 300-pound pull.

Ripcord housing.—To withstand a tensile load of not less than 300 pounds.

Hook-band, parachute pack opening.—Hook is proof-loaded to 25 pounds. Base wire may deflect but shall not disengage eye.

Band assembly—spring parachute pack opening.—Bands are stretched to 100 percent of elongation prior to assembly. After assembly, bands are proof-loaded to 85 percent of elongation of springs. Bands shall lie flat after testing.

Vent ring.—Medium soft rubber 4 inches in diameter. Breaking strength not less than 7 pounds, elongation at least 600 percent.

Weight of Parachute Assemblies

Type of parachute	Weight (pounds, approx.)
NC3–R; 28-foot canopy	22
NS3–R; 28-foot canopy	28½
NB3–R; 28-foot canopy	24½
Smooth Back; 22-gore, 26-foot canopy	19

Note: The addition of the pararaft kit to the above parachutes increases these weights approximately 15 pounds.

APPENDIX III

ANSWERS TO QUIZZES

CHAPTER 1

MEET THE PARACHUTE RIGGER

1. a.
2. b.
3. b.
4. a.
5. c.
6. d.
7. d.
8. d.
9. c.
10. d.
11. c.
12. a.
13. d.

CHAPTER 2

TYPES AND COMPONENTS OF PARACHUTES

1. d.
2. a.
3. c.
4. b.
5. b.
6. c.
7. b.
8. d.
9. d.
10. d.
11. a.
12. c.
13. d.
14. d.
15. a.
16. b.
17. d.
18. c.
19. b.
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APPENDIX IV

QUALIFICATIONS FOR ADVANCEMENT IN RATING

PARACHUTE RIGGERS (PR)

Rating Code No. 7000

General Service Rating

Scope

Parachute Riggers service, maintain, and repair aviation survival equipment and flight clothing; service and maintain aviator's oxygen-breathing systems and test equipment; instruct personnel in use of parachutes, survival equipment, protective clothing, special equipment packets, oxygen-breathing equipment, and air-sea rescue equipment carried by aircraft.

Emergency Service Rating

Same as General Service Rating.

Navy Job Classification and Codes

For specific Navy job classifications included within this rating and the applicable job codes, see Manual of Enlisted Navy Job Classifications, NavPers 15105 (Revised) codes PR–7300 to PR–7399.

NOTE.—In order to qualify for advancement to PR3, personnel must have met physical qualifications as prescribed in the Manual of the Medical Department for student parachute jumpers and have made at least one premeditated free-fall jump under prescribed conditions with a parachute personally packed under the supervision of a qualified Parachute Rigger.

Qualifications for Advancement in Rating	*Applicable rates* PR
100 PRACTICAL FACTORS	
101 OPERATIONAL	
1. Inspect, rig, pack, handle, stow, and issue all types of personnel parachutes. Be willing to test, by actual jump, under prescribed conditions, any personally packed parachutes when challenged by proper authority	3
2. Demonstrate knowledge of dry locker procedure	3
3. Equip, inspect, stow, and pack all types of standard aviation protective clothing and survival equipment	3
4. Demonstrate knowledge of procedures for making emergency parachute jumps and for use of all survival equipment under emergency conditions	3
5. Use all available types of standard sewing machines	3
6. Use drawings, patterns, and templates in making commonly used types of fabric and webbing assemblies, including covers, shoulder harnesses, slings, and hoists used in naval aviation survival equipment	3
7. Test oxygen and CO_2 cylinders for proper charge; operate oxygen transfer equipment and portable oxygen recharge trailers, observing all safety precautions	2
8. Test all types of standard aviation protective clothing and survival equipment	2
9. Inspect, rig, pack, handle, stow, and issue all types of aerial delivery parachutes	1
10. Construct various types of lift webs and sling assemblies for use on cargo to be dropped with aerial delivery parachutes	1
11. Operate instruments used in the testing of oxygen, including water vapor indicators, halide detectors, and oxygen analyzers	1
12. Operate the oxygen regulator test stand	1
102 MAINTENANCE AND/OR REPAIR	
1. Demonstrate safe and proper use of tools required in maintaining parachutes, oxygen systems, and survival equipment	3
2. Time and adjust standard sewing machines	3

Qualifications for Advancement in Rating	*Applicable rates*
	PR
102 MAINTENANCE AND/OR REPAIR—Continued	
3. Maintain, fit, modify, clean, and test oxygen masks. Replace connectors and valves. Conduct tests on all available types of oxygen regulators, excluding the test stand tests	3
4. Use instruments to determine temperature and relative humidity	3
5. Remove, charge, test, and replace oxygen bail-out assemblies	3
6. Make authorized changes and repairs to flight clothing and personnel protective and survival equipment	3
7. Inspect, test, and install safety belts and shoulder harnesses in accordance with current instructions	3
8. Install standard snap fasteners and grommets, and install and repair slide fasteners	3
9. Recognize stains most frequently found in parachutes, and take appropriate corrective action	3
10. Perform authorized alterations and repairs to parachutes and component parts	3
11. Inspect and service all oxygen-breathing equipment installed in aircraft and make preflight check in accordance with current instructions	3
12. Service CO_2 systems installed in aircraft and make preflight check in accordance with current instructions	3
13. Identify, and use as appropriate, fabrics, tapes, webbings, rubberized material, fasteners, needles, and all components of parachutes and survival equipment	3
14. Maintain oxygen and CO_2 recharge equipment and portable oxygen transfer units	1
15. Remove, test, and replace aviator's oxygen-breathing cylinders, lines, connectors, valves, and all available types of regulators	1
16. Maintain oxygen regulator test stand	1
17. Maintain, replace parts, and repair all available standard types of sewing machines	1
103 ADMINISTRATIVE AND/OR CLERICAL	
1. Observe all safety precautions and procedures in the handling and maintenance of parachutes and oxygen-breathing and survival equipment	3

	Qualifications for Advancement in Rating	*Applicable rates*
		PR
103	ADMINISTRATIVE AND/OR CLERICAL—Continued	
	2. Observe all applicable safety precautions while working in and around aircraft	3
	3. Use NavAer Publications Index to locate, identify, and obtain technical publications	3
	4. Instruct personnel in the use of parachutes and aviation survival equipment	2
	5. Instruct and supervise personnel engaged in the maintenance of parachutes and survival equipment	1
	6. Maintain complete and current files on applicable manuals, training courses, and technical publications concerning the operation and maintenance of all parachutes and aviation survival equipment	1
	7. Prepare complete and accurate records and reports of the inspection, testing, and packing of aviation survival equipment as required by current directives	1
	8. Organize and administer a parachute loft or repair facility for aviation survival equipment	C
	9. Determine needs for, arrange for, and supervise instruction of personnel engaged in maintenance of survival equipment	C
	10. Use allowance list, parts catalogs, and forms in the requisitioning, salvage, and survey of parachutes and aviation survival equipment	C
200	EXAMINATION SUBJECTS	
201	OPERATIONAL	
	1. The methods of inspecting, rigging, packing, handling, stowing, and issuing all types of personnel parachutes	3
	2. Dry locker procedure	3
	3. Techniques of packing, inspecting, and handling aviation survival equipment, including protective clothing and special equipment kits	3
	4. Methods of use of standard aviation survival equipment under emergency conditions	3
	5. Safety precautions and procedures in handling and stowage to be observed with oxygen, CO_2, and related equipment	3
	6. Symbols and terms on blueprints and drawings used in construction of parachutes and aviation survival equipment	3

Qualifications for Advancement in Rating		Applicable rates PR
201	OPERATIONAL—Continued	
	7. Nomenclature, types, component parts, materials, and construction of parachutes	3
	8. Oxygen test procedures	1
	9. Use of oxygen regulator test stand	1
202	MAINTENANCE AND/OR REPAIR	
	1. Tools used in maintenance and repair of parachutes and aviation survival equipment	3
	2. Nomenclature and methods of servicing and timing all standard sewing machines used in the parachute loft	3
	3. Methods used to identify stains on parachutes, and corrective action required	3
	4. Procedures for testing and installing safety belts and shoulder harnesses	3
	5. Tensile strengths, durability, and other properties and general characteristics of fabrics currently used in parachutes and aviation survival equipment	3
	6. Types, styles, and sizes of fasteners and grommets used in parachutes and aviation survival equipment	3
	7. Standard procedures used in repair of parachutes and aviation survival equipment	2
	8. Procedures for servicing, inspecting, and maintaining oxygen-breathing and CO_2 equipment	1
	9. Procedures for maintaining and repairing sewing machines used in the parachute loft	1
203	ADMINISTRATIVE AND/OR CLERICAL	
	1. Safety precautions to be observed in the operation of the parachute loft and the aviation survival shop	3
	2. Use of technical publications pertaining to parachutes and aviation survival equipment	3
	3. Procedures for requisitioning, stowing, custody, and issuance of, and accounting for, materials for parachutes and aviation survival equipment	2
	4. Types and purpose of records, logs, and reports required for parachutes and aviation survival equipment	2
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